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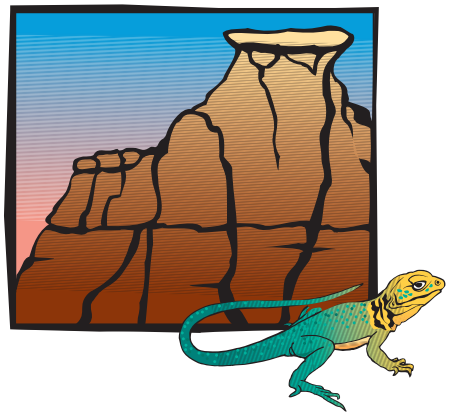

Adventures in Colorado National Monument

Teacher's Guide and Activities

by Winston Dines

Adventures in Colorado National Monument:
Teacher's Guide and Activities

Colorado National Monument Association
Visitor Center
Fruita, Colorado 81521
970-858-3617

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What is the Colorado National Monument Association?
Become a Member

The Colorado National Monument Association (CNMA) is a not-for-profit educational association whose purpose is to assist the Colorado National Monument with its educational, scientific, and historic projects. The CNMA uses proceeds from bookstore operations, membership fees, grants and donations to support interpretive programs at Colorado National Monument and educational outreach programs in the local area, to fund research projects, and to heighten the educational experience of visitors to Colorado National Monument by providing modestly priced or free information brochures.

A member organization, the CNMA offers special programs and a periodic newsletter to its members. Members also receive a discount on purchases made in the CNMA bookstore and in other cooperating association bookstores across the country. If you would like to join the CNMA, please fill out the form below and mail with payment to:

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Fruita, CO 81521

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Adventures in Colorado National Monument
Order Form

Thank you for supporting Colorado National Monument Association's educational efforts. We hope you have found the information in this teacher's guide useful. The CNMA welcomes any comments you have.

To order more copies of this guide, please call (970) 858-3617 ext. 307 or 308. Or, mail or fax the completed form below to: Colorado National Monument Association, Colorado National Monument, Fruita, CO 81521; fax (970) 858-0372. Personal checks, money orders, and credit cards are accepted.

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Introduction to the Teacher's Guide and Activities

Adventures in Colorado National Monument: Teacher's Guide and Activities *has been developed to increase awareness of the outstanding natural classroom and learning environment that is "right next door" at Colorado National Monument. To that end, the guide has two purposes. The first is to give detailed information about geologic, plant, animal, historic and cultural resources that make the monument so unique and worthy of federal protection. The second is to provide area teachers and other interested parties with site-specific, hands-on activities for use on field trips to the Colorado National Monument. Above all, this guide is intended to help visitors to explore safely and knowledgeably the many exciting features of the canyons and mesas.*

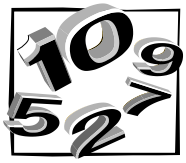
Who Will Use the Guide

While this guide is a valuable reference about Colorado National Monument for all ages, it is primarily designed for use by fourth to eighth grade teachers in the Mesa County, Colorado schools. To assist these teachers in meeting their curriculum requirements, all activities have been formulated to meet 2000 Mesa County Valley School District #51 Educational Content Standards. Black and white square icons at the top of each activity indicate different curriculum subjects, such as Language Arts, Science, or Social Studies, that are aligned with the field activity. Content Standards are outlined in the back of each chapter.

What is in the Guide

The guide is divided into six parts. Chapter One gives useful ideas for planning and preparing for a field trip to Colorado National Monument. Chapters Two, Three, and Four concentrate on the plant life, wildlife, and geology of the area. Land management agencies in the region are defined, and the history of the National Park Service and Colorado National Monument are outlined in Chapter Five. The last part is the Index.

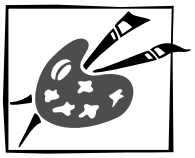
CONTENT STANDARDS



Math

Science

Language Arts



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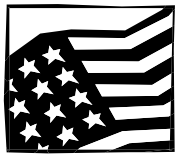


Social Studies

Introduction to the Teacher's Guide and Activities

How to Use the Guide

Using the teacher's guide is easy, because the chapters are all arranged in the same way. Each begins with in-depth background information about a topic, such as geology. The material is concentrated to include key identifications, concepts, and perspectives that will be relevant during the field trip experience. This format creates a useful reference for teachers, trip leaders, or others seeking to learn more about Colorado National Monument. Animals that are commonly observed, plants that are frequently seen, unusual details that might otherwise be overlooked, are among the items covered in the "Background Information" section.

Next, each chapter includes a section devoted to site-specific activities that bring students and teachers into close contact with plant, wildlife, geologic, or historic resources found within Colorado National Monument. Each exercise has a similar "recipe"- like structure that enables first-time field trip leaders as well as experienced outdoor educators to follow the proper sequence of steps to have a positive, exciting learning experience. The structure includes:

~ the purpose of the activity;

~ the best age level to participate in the activity;

~ the amount of time required to complete the activity;

~ the materials needed;

~ the best location (either in the classroom or at Colorado National Monument);

~ the essential background information and context for the activity;

~ how to do the activity, in a "Step-by-Step" process along the trail.

These activities and worksheets can be copied and used in the field or the classrooms. Whenever possible, ways to follow-up on what was learned and experienced are also given.

This combination of background information with exciting and challenging interactive opportunities to seek out the land forms, rock formations, habitats, plants, and animal inhabitants of Colorado National Monument creates a marvelous learning environment for children and adults. The first time field trip leader will find that they learn enough to be comfortable in front of their group. Even the instructor with years of experience will find new tips, ideas, and places to try out for enhancing their programs. Above all, this guide encourages discovery, wonder, and insight among students, while assuring a safe, well-prepared atmosphere for the adults.

Welcome to Colorado National Monument!

May you enjoy your adventures!

CHAPTER ONE

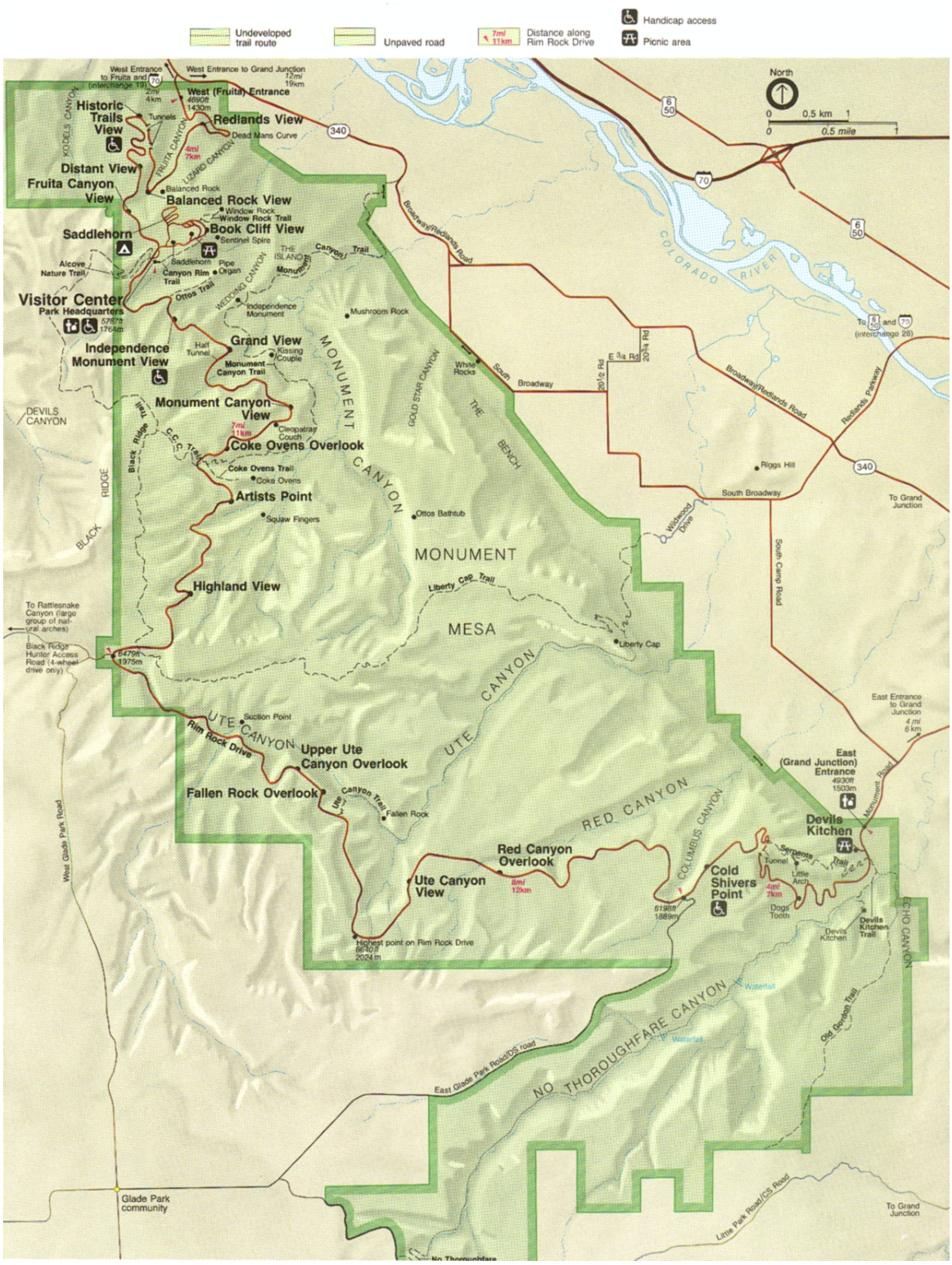
Getting Ready for Your Field Trip to Colorado National Monument

Photo from *Through the Eyes of the Children*
by Diane Hirschinger Gallegos and Tope Elementary Students

Introduction to the Teacher's Guide and Activities

BACKGROUND FOR **TEACHERS**

Map and Guide of Colorado National Monument



What? Where? When?

The Visitor Center

The Visitor Center, also known as Monument Headquarters, is a logical place to begin or end an adventure in Colorado National Monument. Not only does it house the National Park Service offices, but it contains educational exhibits, a slide show, bookstore — as well as flush toilets, public telephone, and drinking fountain! Located on Rim Rock Drive, about 4 miles up from the West (Fruita) Entrance Station, it overlooks scenic Wedding Canyon and the impressive Pipe Organ monoliths. Clustered with the Saddlehorn Campground, the Saddlehorn Picnic Area, as well as the Alcove Nature, Canyon Rim, and Black Ridge trailheads, the Visitor Center is open every day except December 25th. Hours are from 9:00 AM to 5:00 PM, and may vary seasonally. Staff or volunteers are available to answer your questions. Parking is available for cars and buses, and accessible spaces are designated. A cement ramp affords wheelchair access to the Visitor Center.

For teachers and students, the Visitor Center offers valuable information and entertainment. The 12-minute slide show is an excellent introduction to the park and its many resources. Exhibits offer insight into the geology and natural history of the region through photographs, art work, and displays. A small herbarium catalogs the different plants seen in the park. Through the bookstore, students can purchase quality, educational postcards, books, and other souvenirs. Teachers and parents will enjoy the many books about the region, its history and ecology, and other places to visit.

For more information contact:

Colorado National Monument
Fruita, CO 81521
phone: (970) 858-3617
fax: (970) 858-0372
website: www.nps.gov/colm

Saddlehorn Picnic Area

Saddlehorn Picnic Area is located approximately four miles up from the West (Fruita) Entrance Station. Access to it is off of the road through the campground, which is passable by buses. Situated in a pinyon and juniper forest, it has picnic tables, barbecue grills, and plenty of parking for buses and cars. Flush toilets and running water are likely to be available from May until October only. A portable toilet is maintained during the cold, winter months. This picnic area is well suited for school groups. Not only can it accommodate large groups (30 or more people), but it is only a short walk to the Visitor Center. Hikers on the nearby Window Rock, Canyon Rim, Black Ridge, and Alcove Nature Trails will also find it convenient. Sites are taken on a first-come, first-served basis.

There are wheelchair accessible restrooms in the nearby campground.

Devils Kitchen Picnic Area

Devils Kitchen Picnic Area is located by the East (Grand Junction) Entrance Station. It has picnic tables and barbecue grills in an attractive rock enclosure. Drinking water and flush toilets are available in the warmer months, from April to October. During the winter, only a handicapped accessible outhouse is open. Parking is available for vehicles and buses, and there is room for a bus to turn around. Hikes to Devils Kitchen, Old Gordon Trail, No Thoroughfare Canyon, and Serpents Trail all begin nearby. This area gets heavy use by schools and individuals in the spring, so plan an early arrival. Tables are available on a first-come, first-served basis. Its small size makes seating and parking limited: groups larger than 30 people should go to Saddlehorn Picnic Area.

What? Where? When?

Devils Kitchen Picnic Area is accessible for the physically challenged. Two designated parking spaces are next to a paved ramp, giving wheelchairs entrance to the picnic area. Two tables are paved underneath, with one under the rock shelter, and the other in an open area. A restroom with flush toilet is open during the warmer months. In the winter, a portable restroom designed for wheelchair access is maintained.

Saddlehorn Campground

Saddlehorn Campground is on the west side of Colorado National Monument, approximately four miles up from the West (Fruita) Entrance Station. Named for a nearby rock formation, it is located along the canyon rim in a pinyon and juniper forest. The Visitor Center is only a short walk away. Each of the eighty campsites features off-road parking, a picnic table, and barbecue grill. Two restroom facilities with flush toilets and running water are open year-round. Sites are reserved on a first-come, first-served basis and will hold seven people. No group facilities are available at this time. Weekend campfire programs are offered during the summer at the nearby amphitheater. In Loop A, one campsite and the restroom facility are accessible for the physically impaired. No group sites are available. No firewood collecting, or wood fires, are permitted. A fee for camping is charged.

Backcountry Camping

Backcountry camping is allowed in the Colorado National Monument so long as you have a permit from the National Park Service. Group size is limited to seven people. There is no charge for the permit. For the safety of your group, talk to a park ranger about your plans for hiking, camping, and parking your vehicle. For more information, ask at the Visitor Center, or call 970-858-3617.

Drinking Water

Drinking water is available year-round at the Visitor Center and Saddlehorn Campground. The picnic areas have it in the summer only. Water in the canyons is not drinkable, due to contamination by minerals and *Giardia*. Hikers and backcountry campers should plan on carrying their own water, with one gallon per person per day being the recommended amount to drink.

Public Telephones

A telephone for public use is available at the Visitor Center.

Facilities for the Physically Challenged

~ Accessible public restrooms with flush toilets and running water are available at Monument Headquarters and Saddlehorn Campground year-round. Both picnic areas have them in the summer months only. Outhouses, including a wheelchair accessible toilet at Devils Kitchen, are installed for the winter.

~ Accessible turn-outs on Rim Rock Drive are Historic Trails Overlook, Independence Monument View, and Cold Shivers Point. Each of these includes a paved path to an enclosed canyon view. Other turn-outs offer scenic views without leaving the vehicle or sidewalk area of the parking lot.

~ For information about picnic areas and camping, see descriptions above.

What? Where? When?

Scenic Features

Colorado National Monument was set aside in 1911 for protection as a National Monument because of its unique examples of erosion and geology. "It preserves one of the grand landscapes of the American West," so states the official Colorado National Monument Map and Guide. The high plateaus contrast with the deeply cut and colorful canyons. Eons of time are exposed in the layers of rock, some as old as those found in the lower levels of the Grand Canyon. The mysteries of the passage of time, and the forces of nature are revealed in the spires, monoliths, talus slopes, and drainages. A canyon wren calls from along a cliff, and a lizard skitters across a rock; each is a part of the complex of wild creatures that inhabit this land. Stand along the canyon rim or wander in one of the canyons. The scenery of Colorado National Monument is unforgettable.

To reach Colorado National Monument, you may enter from either Grand Junction, known as the east side, or Fruita, the west side. Stretching between the two entrances is Rim Rock Drive, from which all turn-outs, trails, and facilities may be reached.

Several small parking lots off Highway 340 and Broadway/Redlands Road also offer parking and access to the lower regions of the park.

Rim Rock Drive

Rim Rock Drive is a paved, two-lane road that traverses the monument for 23 miles. It can be driven in either direction. Scenic turn-outs and viewpoints provide opportunities to see the dramatic canyons and cliffs below. Interpretive signs help the visitor to learn about the surrounding geology and history. At many points along the drive, evidence of the hard work and craftsmanship of the people who built the road is visible. Look for vertical lines in the rock that mark drilling or quarrying that created the road. Observe the carefully matched rock walls that line the road and turn-outs. The tunnels are more examples of how the labors of the Works Progress Administration, Locally Employed Men (LEM), and the Civilian Conservation Corps helped make the canyons and vistas accessible to the public, yet still maintained the integrity and beauty of the area.

Because the road is only two lanes wide, full of curves, turns, and panoramas, care should be taken at all times when traveling on it. The posted speed limits should be obeyed, and drivers should be alert for rocks and wildlife along it. Special attention should be given to staying on the correct side of the center divider; to passing only in designated areas with clear views of oncoming traffic; and to watching for other visitors walking, biking, or turning on or off the route. Headlights are required in the three tunnels, and are recommended as an extra safety measure all along the drive.

What? Where? When?

Independence Monument

Independence Monument is one of the most famous sights in the monument. A 450-foot high spire of red rock, it stands alone in Monument Canyon. It can be reached by hiking Monument Canyon Trail from either the top or bottom entrance. Otto's Trail, Independence Monument View, and Grand View along Rim Rock Drive, or Book Cliff View on the Campground Loop Road, are other places along the mesa top from which to see this impressive example of the powerful forces of erosion.

The Coke Ovens

The Coke Ovens are another renowned feature at Colorado National Monument. They are a series of colorful rocks which have been worn away by wind, water, and freezing and thawing temperatures. Now, they are rounded in shape, reminding one of coke ovens or beehives. They may be seen from the Coke Ovens turn-out on Rim Rock Drive. A hike in Monument Canyon, or along Coke Ovens Trail, will also take you there.

Other Formations

Numerous other rock formations, canyons, erosional features, and spectacular views are found throughout the Colorado National Monument. Give yourself plenty of time to travel through this fascinating area, where forces within and upon the Earth are so dramatically revealed.

The trails of Colorado National Monument offer spectacular views wherever you travel. If steep cliffs, colorful canyons, and fascinating erosional patterns and features are sought, they abound along the many miles of paths. If solitude amongst the pinyon and juniper trees and other desert flora is desired, hikes will take you there. If wildflower displays, ephemeral waterfalls, and wildlife viewing beckon, careful timing with the seasons, weather, and time of day may reward you amply. No matter where you walk within the Colorado National Monument, however, caution should be taken to bring plenty of water, wear sturdy hiking shoes, and let someone know where you are going. Extra care should be taken when nearing canyon rims or in areas of cryptobiotic soil crust. Because of the many kinds of wildlife in the park, no pets are allowed on the trails or in the backcountry. As this is a national monument, all rocks, feathers, flowers, and other discoveries that you make must stay here. Enjoy them where you find them, because they are protected and preserved under federal law.

The Alcove Nature Trail

The Alcove Nature Trail begins and ends at the Visitor Center. This self-guiding nature trail follows the cliffs and red rock of the Entrada and Kayenta Formations to a sandstone alcove one-half mile away. A brochure detailing information about the plants, animals, and geology may be purchased at the Visitor Center and at the trailhead. A version adapted for children and Junior Rangers is also available. Distance: 1 mile round trip.

What? Where? When?

Trails

Black Ridge Trail

Black Ridge Trail is the highest in the park, and also traverses the youngest rock in the Colorado National Monument. The hiker goes in and out of the monument boundary onto Bureau of Land Management land. Pinyon and juniper forest alternates with areas of open space, and always spectacular views of the canyons and mesas accompany the up and down terrain. The trail may be accessed at either the Visitor Center, or off Rim Rock Drive, between the West Glade Park Road and Highland View Overlook. Liberty Cap Trail and the C. C. C. Trail also connect with it. Distance: 5 1/2 miles one-way.

The C.C.C. Trail

The C.C.C. Trail is a short trail that connects upper Monument Canyon Trail with the Black Ridge Trail. It is named for the Civilian Conservation Corps, one group of depression era road builders whose labors on Rim Rock Drive, park trails, and buildings opened the area for exploration by the general public. They built this trail to give them access to their working and living areas along the canyon edge. The trail begins at Rim Rock Drive, near the upper Monument Canyon Trailhead, between Artists Point and Coke Ovens Overlook. Distance: 3/4 mile one-way.

Canyon Rim Trail

Canyon Rim Trail begins at the Visitor Center and ends at the Book Cliff Overlook and Shelter one-half mile away. A level trail, it travels along the rim of Wedding Canyon, offering spectacular cliff, canyon, and mesa top views, as well as panoramic vistas of the Grand Valley. This is a short but enjoyable way to travel to and from Saddlehorn Campground and the Visitor Center. Distance: 1 mile round trip.

Coke Ovens Trail

Coke Ovens Trail begins approximately one-half mile down the upper section of Monument Canyon Trail. While Monument Canyon Trail descends steeply to the canyon floor from Rim Rock Drive, the Coke Ovens Trail turns off to follow along the canyon rim. This relatively flat hike goes through a dramatic sequence of rock formations to a fenced overlook above the Coke Ovens rock formation. How the forces of wind, water, temperature, and gravity have broken down layers of rock to their present beehive shapes is fascinating to contemplate from the viewpoint. Gnarled juniper trees, colorful desert shrubs and wildflowers accompany you back up to the mesa top. The trail is accessed off Rim Rock Drive, between Artists Point and Coke Ovens Overlook. Take the upper Monument Canyon Trail down until Coke Ovens Trail splits off to the right. Distance: 1 1/2 miles round trip.

Devils Kitchen Trail

Devils Kitchen Trail begins on the east side of Rim Rock Drive, just up from East (Grand Junction) Entrance Station, and across from the Devils Kitchen Picnic Area. An easy trail for hiking, with only a few ascents, it ends at a cluster of towering rocks. A variety of habitats, from sagebrush to slickrock to riparian, make it an excellent trail for short field trips, and younger age groups. This area is heavily used by visitors. Caution should be taken to stay on the main trail and not wander onto the numerous dead-end footpaths that take off from it. Parking can also be limited in the area, so plan an early arrival. Distance: 1 1/2 miles round trip.

What? Where? When?

Liberty Cap Trail

Liberty Cap Trail may be accessed from Rim Rock Drive, between the West Glade Park Road and the Highland View Overlook, for a downwards hike. Seven miles later it ends at the Colorado National Monument boundary in the Redlands. Used by hikers, horseback riders, and cross-country skiers in the winter, much of this trail descends gently across Monument Mesa. This area was much used by John Otto in his years in the canyons. He flew many flags from atop the Liberty Cap rock feature, which marks the steep portion of the hike. Here, the trail drops down 1100 feet to the valley floor in just over one-half mile. If the hike is done in reverse, parking is available at the end of Wildwood Drive, off South Broadway and Colorado Highway 340. Distance: 7 miles in length, one-way.

Monument Canyon Trail

Monument Canyon Trail is one of the premier hikes within the park. Steep cliffs, unusual and colorful rock formations, and classic canyon flora and fauna reward the hiker all along the trail. Independence Monument, Kissing Couple, and Coke Ovens are also accessed from this trail. The hiker passes through a dramatic sequence of rock layers that seem to unroll, one atop the other, like a flag unfurling. This impressive geology also requires that the hiker pay careful attention to foot placement, as steep drop-offs are common in some parts of the upper canyon. School groups on a day hike may prefer to begin at the upper canyon and hike downwards. Those camping overnight may choose to begin in the lower canyon. This canyon was what inspired area residents to work to protect these lands as a national monument. Lower Monument Canyon may be reached off Colorado Highway 340/Broadway-Redlands Road, while Upper Monument Canyon trailhead is located between Artists Point and Coke Ovens Overlook on Rim Rock Drive. Distance: 6 miles in length, one-way.

No Thoroughfare Canyon Trail

No Thoroughfare Canyon Trail is one of the longest and most difficult trails in the Colorado National Monument. There is a route to the second waterfall, but there is not a trail beyond. At and beyond the second waterfall can be hazardous and children must be closely supervised and not allowed to climb in this area. It can be hiked in full or in part. Impressive vistas of geologic formations, canyon walls, and desert riparian habitat highlight this hike. The developed trail ends part way up the canyon, and the remaining hike is on foot paths and routes of your own choosing. Waterfalls and seasonal pools in the drainage offer important habitat for wildlife. Tempting as these pools are, hikers are urged to avoid getting into, or hiking through them, because they are important nursery areas for toads, frogs, and other amphibians. Our fleeting enjoyment can mean disaster for the future of area wildlife. Distance: 8 1/2 miles in length, one-way.

What? Where? When?

Old Gordon Trail

Old Gordon Trail splits off from the Devils Kitchen and No Thoroughfare Canyon Trails to climb gradually through riparian, slickrock, and pinyon-juniper habitats. The upper portion of Old Gordon Trail is on private land and can not be accessed by the public. Plan to start and finish this trip from the bottom. Remnants of an old logging and highcountry access road are highlights of this trail, as are superb vistas of Colorado National Monument as a monocline. Views of the Precambrian basement rock through the Morrison Formation are colorful and defined. While this is an excellent choice for a field trip, great care must be taken to follow the correct trail, as many small and confusing footpaths crisscross the area. Distance: 4 miles in length, one-way.

Otto's Trail

Otto's Trail is named for John Otto, one of the founders of the Colorado National Monument, and its first caretaker. This short, relatively flat trail follows a pinyon and juniper dotted mesa top until it ends at the rim of Monument and Wedding Canyons. Dramatic views of the canyons, Independence Monument, and the colorful cliffs and rock formations are featured. The canyon rim at the end of the trail is well fenced and secure for all ages. This trail is accessed from Rim Rock Drive, between Independence Monument View and the Visitor Center. Distance: 1 mile round trip.

Serpents Trail

Serpents Trail begins on the west side of Rim Rock Drive, just up from the East (Grand Junction) Entrance Station, and across from the Devils Kitchen and No Thoroughfare Canyon trailheads. It is widely used by area residents for a physical workout—it has 700 feet of elevation gain as it snakes its way from the canyon floor to the mesa top. Often called the "crookedest road in the world," it was one of the original roads into the monument highcountry. Fifty switchbacks traverse the steeply slanted Kayenta and Wingate rock formations, and offer dramatic canyon and valley vistas. This hike leaves one breathless from both the elevation gain and wonder at the tremendous forces within the Earth. Distance: 4 1/2 miles round trip.

Ute Canyon Trail

Ute Canyon Trail begins at Rim Rock Drive near the Fallen Rock Overlook. It drops down 400 feet in one-quarter mile on a very steep, zig-zag course to the drainage of Ute Canyon. Once in the canyon, the trail is not developed, so the hiker may follow the drainage with its willows and cottonwoods on routes of their own choosing. This canyon is more narrow and steeply walled than some of the others. Approximately five miles down, Liberty Cap rock marks the intersection of the Ute Canyon with Liberty Cap Trail. Hikers can use Liberty Cap Trail to return to Rim Rock Drive, or descend on it from the canyon to Wildwood Drive. Distance: 7 miles one-way.

Arranging a Field Trip
With Colorado National Monument

BACKGROUND FOR **TEACHERS**

When preparing for a visit to Colorado National Monument, the following arrangements will make the experience more comfortable, safe, and enjoyable. If you take time to get organized and familiar with the surroundings, both you and your students will benefit. By coordinating with the Colorado National Monument staff, you will not be as likely to arrive in the same place at the same time as other groups. No special skills as an outdoorsperson are needed to lead a field trip here. What is most valuable is common sense, and time spent in preparation.

1 Review the activities and background information in this manual. They will give you ideas of what to do on your field trip, and where to do it. Each activity has been formulated to take State of Colorado Educational Content Standards into account, so that you may be assured that your outing will be integrated with your curriculum needs. Moreover, the activities are designed to give the teacher a complete plan — or recipe — of what to do; where and how to do it; how to get ready for it; materials needed; length of time involved; extensions for the classroom; and ways to adapt it for other ages or needs. A list of resources for further study is also included.

2 Contact Colorado National Monument staff regarding the date, time and place of your arrival. By coordinating with them, they can alert you about others who may be using the same trails, picnic areas, or campground. If you do this a week or more in advance of your arrival, you can make adjustments to your schedule without as much difficulty as if you show up with no advance arrangements.

3 No National Park Service staff is available to lead your field trip or activities because of budgetary constraints within the federal government. You will be on your own. However, the Visitor Center is open, and staff there can assist you with information about area facilities and features. A short slide presentation, together with interesting, interpretive exhibits about area geology, natural and human history make the Visitor Center a worthwhile educational stop. Many books and publications about natural and cultural history are for sale in Colorado National Monument Association's bookstore, and can be useful resources for your field trip.

4 Consult the Colorado National Monument map in addition to this manual for information about trails, picnic areas, restrooms, water, parking areas, campsites, etc. Additional maps are free of charge and available outside Park Entrance Stations and at the Visitor Center.

5 Consider the type of transportation that you will be using to reach the Colorado National Monument. Look in the "Facilities" descriptions in this chapter for information on the parking and turn-around areas for buses, carpools, and physically challenged access. If a school bus is to be used, not all turn-outs on Rim Rock Drive, or all parking areas, will accommodate a large bus. For the sake of the driver, and the resulting safety of your group, plan the departure and return of your hike or outing with this in mind. If you are traveling in a carpool, plan carefully also. During the fall and spring, many people use the Colorado National Monument, and in areas such as Devils Kitchen, Serpents Trail, and Lower Monument Canyon, parking can be limited. Arriving early in the day is the best way to assure space for your form of transportation.

Preparing the Students

A very important part of going on a field trip is being properly prepared. What is tolerable in the classroom may not be acceptable in nature, where changes in weather can happen at any moment.

With the comforts of home far distant, students must carry their food, water, and protection from the elements on their backs. As their leader, it is really important to be clear that the safety of the group, as well as individuals, is at stake. Making adequate preparations is an essential part of any field trip.

A list of supplies that each student should bring with them on the hike is given below. You may want to ask the class to write their own list of what to bring, or copy off this list to send home. In either case, discuss preparations several days ahead of time. Send reminders home. Some teachers may find it useful for students to bring in supplies ahead of time, to assure that things will be remembered. Whatever your technique, remind students that they are responsible for their comfort and safety on the trail. Lastly, for the most forgetful class members, an evening reminder call may be worthwhile.

Every Student Needs to Bring These Items on the Field Trip

- ☐ Backpack with sturdy straps.
- ☐ Good walking shoes. (No flip-flops, sandals, or open-toed shoes are allowed. Remember, there are cactus out there!)
- ☐ Jacket or sweater. (Canyons don't get sun as soon as mesa tops, and lose it sooner.)
- ☐ Hat and gloves. (For extra warmth in cool to cold weather.)
- ☐ Sun hat. (To stay cooler in warm weather, and protect from the sun.)
- ☐ Sunscreen lotion.
- ☐ Rain jacket in most seasons. Pack a parka in winter.
- ☐ Lunch and plenty of extra snacks. (Remember you will be moving around and get extra hungry on the trail.)
- ☐ Full water bottle. (Your body needs to replenish any moisture that it uses up hiking. Bring plenty along to stay comfortable.)
- ☐ Trash bag. (Plan to carry out everything that you bring in—there is no trash pickup other than YOU.)

A Note to Students

When you are on a field trip, you never know what is going to happen. That makes the day into an adventure, as well as a lot of the fun. Time flies by, and then it is lunch. Being unprepared, however, can make the experience unpleasant, even unsafe. Without the right footwear, you can get blisters, cactus spines, sprained ankles, or worse. Without warm clothing, you can face chills, hypothermia, and become a serious problem for the group. Without water, you can face dehydration, headaches, heat exhaustion, and need medical attention. All these conditions are easily remedied by **BEING PROPERLY PREPARED!**

Field Trip Itineraries

BACKGROUND FOR **TEACHERS**

As you plan a field trip, use these "itineraries" to choose the best age and location for each activity. *Adventures in Colorado National Monument: Teacher's Guide and Activities* includes chapters on geology, wildlife, plants, and human use of the monument. Each is listed with the activities, the age level for use, and the best location in which to do the activity. These options are intended to assist in your preparations, but are by no means mandatory. Please feel free to mix and match to customize your students' experience at the Colorado National Monument with your curriculum goals and need. Remember, black and white square icons indicate which Educational Content Standards are met through each activity.

Plant Life

Botanical Journal	4th-8th grade	Devils Kitchen, Old Gordon Trail, No Thoroughfare Canyon, Monument Canyon, Rim Rock Drive
Magic of a Drop of Water	4th-8th grade	No Thoroughfare Canyon, Devils Kitchen, Monument Canyon, Alcove Nature Trail Black Ridge Trail
Plant Scavenger Hunt	4th-8th grade	Devils Kitchen, Old Gordon Trail, No Thoroughfare Canyon, Monument Canyon, Rim Rock Drive
Floral Investigations	4th-6th grade	Classroom or trail side
Territories	5th-8th grade	No Thoroughfare Canyon, Monument Canyon, Black Ridge Trail
Crossword Puzzle	6th-8th grade	Classroom

Wildlife

Developing Wildlife Viewing Skills	4th-8th grade	Classroom, school yard
Animal Signs and Scat	4th-8th grade	Monument Canyon, No Thoroughfare Canyon
Lizard Patrol	4th-8th grade	Devils Kitchen, Old Gordon Trail, Monument Canyon, No Thoroughfare Canyon
Stalking	4th-8th grade	Lower Monument Canyon, Black Ridge Trail or school yard
Who Lives Here?	4th-8th grade	Lower Monument Canyon, Liberty Cap, Black Ridge Trail
Wildlife Observation Sheet	4th-8th grade	Monument Canyon, No Thoroughfare Canyon, Devils Kitchen, Otto's Trail, Independence Monument View

Field Trip Itineraries

Geology

Three Types of Rock	4th-8th grade	Saddlehorn or Devils Kitchen Picnic Areas; Old Gordon or Devils Kitchen Trails; or classroom
Make a Stratigraphic Column	4th-8th grade	Classroom or school yard
Stratigraphy Hike	4th-8th grade	Coke Ovens Trail
Erosion and Weathering Hike	4th-8th grade	Old Gordon Trail
Mapmaker, Mapmaker	4th grade & up	Classroom
Let's Get Oriented	5th grade & up	Classroom or Rim Rock Drive turnout
Geologic Pursuits	4th-8th grade	School yard

Beyond the Scenery: An Introduction to the National Park Service

These Lands Are Your Lands	5th-8th grade	Classroom

Colorado National Monument Passes

Private Vehicles

Private vehicles, not including commercial or educational vans or buses, can get a seven day permit. This gives the vehicle unlimited entrance privileges for those days. When parking or leaving a private vehicle, be sure to show permit on the dashboard.

Fees for Hikers and Bicyclists

People walking into the park, and bicyclists, can get a seven day permit. This gives the individuals unlimited entrance privileges for those days.

Colorado National Monument Annual Passport

For visitors, hikers, and bicyclists who anticipate regular use of Colorado National Monument throughout the year, an annual passport is the easiest way to pay fees. Good only for the monument for unlimited entrances for one year for all persons in a vehicle.

National Parks Pass

The National Parks Pass is an annual pass good for free entrance into any National Park, Monument, Recreation Area, Historic or Cultural Site in the National Park Service across the United States.

Fee Waivers for Educational Groups

A NOTICE TO MESA COUNTY VALLEY SCHOOL DISTRICT #51:

An agreement, known as a "blanket fee waiver", between the National Park Service and the Mesa County Valley School District #51, is made every year. The agreement states that if students arrive in a District #51 school bus, no fee will be charged. However, if students are to arrive by carpool, the teacher needs to notify the National Park Service by letter in advance to have the fee waived.

Educational institutions may qualify for fee waivers if the following three criteria are met:

1) The organization is a "bona fide" institution of learning. This would include school districts and private schools.
2) The educational or scientific purpose of the visit relates directly to park resources. The visit is not primarily for recreation.
3) A statement explaining what the educational purpose of the visit is must be sent on school letterhead to Colorado National Monument IN ADVANCE OF THE TRIP.

Commercial Vehicles

A commercial vehicle is defined as one profiting financially by use of Monument Resources. Fees are assessed based on capacity of the vehicle transporting the group.

1 – 6	passengers
7 – 25	passengers
26 +	passengers

Preparing for a Field Trip

BACKGROUND FOR **TEACHERS**

A successful field trip is a combination of good scenery, good luck, and, most of all, good planning. Fine weather helps, but is not crucial. Being ready for whatever conditions and situations come along is vital to the safety and quality of the experience. The following information and ideas will help to assure that you, your chaperones, and students are ready for anything, a key element in having a memorable, fun, and learning-filled trip.

Before You Leave

While each school may have its own forms and procedures for getting ready for a field trip, the calendar below is a helpful reference for trip planning.

Three weeks in advance of the event, send home a notice that you will be going on a field trip. Along with it, request that parents accompany your group. This gives parents adequate time to make arrangements. Depending on the type of trip, and its destination, you may want to invite specific parents to accompany you. For example, people with outdoor skills, such as birding or geology, or with medical training, can be especially helpful. Include a student permission sheet with your letter. As the sheets are returned, place them in a special file for your records.

Two weeks in advance, review the *Colorado National Monument Teacher's Guide and Activities* for activities to do with your class. As part of your plan for the field trip, make a list of materials that you will need. Begin preparations to get the supplies. Can others help you acquire them? Can they be donated? Would sending a note home with students assist in getting them? These tasks can be delegated to a student teacher or class parent.

One week before the outing, discuss the field trip to Colorado National Monument with your students. Go over appropriate clothing, footwear, and supplies for different weather conditions. Cover subjects of food, water, and group and individual safety on the trail. Students can be assigned homework of making a list of what to take with them. This is especially useful in advance of a camping trip, where so many details must be planned for. The lists can be reviewed in class and a master list for everyone developed from which to work.

A second preparation for all students is to examine *"Do the Right Thing"* (p. 28). Teams of students can be assigned to investigate different topics and report back to the group with their discoveries. Work in the library, or contact with local agencies for information, can be incorporated. Alternatively, ask the class to establish their own rules for the field trip, using the "Do's and Don'ts" as a stepping off point. The technique of self-monitoring works very well for this age group. Often, students are more strict (and successful) in enforcing their own rules than the teacher is in imposing them. Make sure, however, that the key rules (no collecting, no littering, staying on paths, safety around cliffs, and loose rocks, staying with the group, etc.) are included on all lists.

A third preparation for the field trip is to do any preliminary exercises or activities from the manual with your class. For example, if you are a fifth grade teacher studying about birds of prey, try some of the activities for enhancing wildlife observation skills before your visit to the monument. If you are an eighth grade teacher going on the "Stratigraphy Hike", you may want to make "Geologic Time Columns" in the classroom, so that the concepts of formations of rock overlying one another are already understood. If you are studying plants, dissecting a flower with "Floral Investigations" might be useful background for the "Plant Scavenger Hunt" or "Botanical Journal".

Preparing for a Field Trip

The weekend before the trip, or at another convenient time, preview the trail that you plan to take with your class. This is among the most important preparations because, in one to two hours on your own, you can get acquainted with the area, its beauties, hazards, and residents. This will help you time and place the activities, breaks, snacks, and lunch, along the trail. Furthermore, you will know the trail, and feel more confident leading the group along it.

The Day Before

Finalize your student roster. On one side of a piece of paper, list all students together with a parent or guardian name, and telephone number(s) to call in an emergency. Also, include the telephone numbers of your school and the monument in case of problems. Do not forget to include information on you and the chaperones. Copy this list for the school, for each chaperone, and for yourself.

Note any known medical problems, such as diabetes, asthma, or allergies to insects or bee stings, on this list. Chaperones also need to be aware of these conditions or concerns.

Copy a map of the monument. The back side of the student roster is a good place to copy the Colorado National Monument map, highlighting areas where you will be going. Be sure to show planned meeting places, parking areas, lunch spots, etc. for drivers. If you will be going into the park from an area not listed on the map, or if you think parents might need written directions to the meeting spot, write them on this sheet also.

Check about the insurance coverage and seat belts of drivers. If you are using a carpool, double check that all parent drivers have adequate insurance, and working seat belts. Doing this ahead of time will mean you do not have to scramble the day of the trip.

Pack your gear the day before to get a better idea of how much your pack will handle. No matter how heavy your pack may feel, do not cut back on "The Teacher's Ready For Anything" elements listed on p. 31. Instead, ask students and chaperones to carry extra curriculum supplies, water bottles, or clothing.

Double check the weather. If there is any chance of unsettled or problem weather, be sure to get an updated weather report the night before the trip. Flash flooding can happen as a result of local rainfall. Beware and watch the weather. If you must cancel due to weather, the sooner you do it, the easier it is for parents. When you just are not sure what to do, err on the side of caution. It is far better to reschedule than to jeopardize health, safety and nerves. If rain appears to be a possibility, pack trash bags for surprise rain jackets for the class. Trash bags are not especially attractive, yet they are so much appreciated for protection in a sudden downpour that they are invaluable to bring along. On the other hand, if weather appears to be sunny and hot, prepare some extra water bottles, or a cooler of ice, for enjoyment at the end of the hike.

Now you are ready for your field trip. It is time to enjoy your adventures and explorations, which will go smoothly thanks to your good organization and planning!

Do the Right Thing
Using Good Manners in the Out-of-Doors

BACKGROUND FOR **TEACHERS**

What should the rules for a field trip be? Each teacher and school has standards of behavior and safety that they consider essential. Similarly, Colorado National Monument, as part of the national park system, has policies established to "preserve and protect" both the resources in the park, and the visitor trying to enjoy them. All members of a field trip must respect and abide by these regulations.

1 **No collecting** of rocks, plants, artifacts, bones, lizards, insects, bird feathers, or any other "treasures" found within Colorado National Monument boundaries is permitted. Everything is protected under federal law so that they may remain part of the complex of eco-systems in the National Parks, into the future. By leaving things as they are, we have a remarkable opportunity to insure that our children, and their descendants, can also visit and appreciate the marvels that we see today.

If you find something special along a trail, be it a rock, flower, lizard, or insect, look at it, enjoy it, even make a record of it by drawing, photographing, or writing about it. Show it to others in your group, but leave it where you found it.

2 **Do not disturb wildlife**, including mammals, birds, amphibians, reptiles, fish, insects, and spiders. This means that splashing in a creek where frogs have laid their eggs is not acceptable. Climbing on a rock where peregrine falcons or other birds are nesting, or throwing rocks to make a rabbit or snake move, are forbidden.

For your safety, do not pet, feed, or handle any wildlife. Some animals can carry disease, while others can inflict painful bites. Avoid rodent nests and do not touch rodents dead or alive due to Hantavirus infection. Leave your pets at home. They are not permitted in the backcountry, and are allowed only on leash in parking lots and on roadsides. Horses are the only exception: they are allowed in several areas in the park, and are given right-of-way on those trails.

If you do spot wildlife in the Colorado National Monument, stop, stand still, and watch it. By keeping your noise and movements to a minimum, you may be able to observe a lizard catching a fly, a deer chewing its cud, a raven bringing nesting material to its mate. Thousands of stories and dramas unfold around you. See how many your class can discover.

3 **Defacing rocks is against the law.** This means that carving, scratching, scraping, painting on rocks, such that you leave a visible mark, is not only wrong, but punishable with fines.

Do the Right Thing
Using Good Manners in the Out-of-Doors

Other Do's and Don'ts

Do carry out all trash. This includes chewing gum, scraps of bread, orange peels, apple cores, even sunflower and watermelon seeds! Because this is a desert climate, decomposition does not occur at a rapid rate. Trash simply dries out and stays there permanently, creating an eyesore for everyone who passes. No matter what others have told you, animals are not going to line up to eat your leavings. Nor is it good for them to do so, as they can endanger their own survival, or, like the deer at the Royal Gorge in central Colorado, become dangerous nuisances for visitors and management alike.

Do stay on designated trails. Established trails are often the fastest and safest routes to get to where you want to be. Even if you can see the trail directly above or below you, do not cut across switchbacks. Not only is this dangerous for you, but it can cause damaging erosion to the trail system. Especially in the Devils Kitchen and Serpents Trail area, many footpaths go off in all directions. Be careful to stay on the main trails, as the unauthorized trails may not take you where you planned. Some end at drop-offs; others travel across loose or unsafe rocks that can roll down and cause injury. Use the map and instructions to the activity to guide you to the places that you want to be.

Do let someone know exactly what your plans are. When hiking in the backcountry, it is important to let someone know where you are going and when you plan to return. That way, if you do not return as expected, help can be sent more quickly, and to the right place.

Do carry plenty of drinking water with you. In spite of its location, water in the canyons is not pure. It may contain harmful chemicals, such as arsenic, or *Giardia*, a protozoan carried in the feces of cattle and humans. To avoid painful intestinal problems, careful treatment of all water in the backcountry before drinking it is required. (For more information on techniques for treating water, see your local outdoor equipment supplier, or check out a book from the library.) For day hikes, it is easiest to bring an adequate supply from home. Estimate about one gallon per person per day, with more on hot days. An ice chest with cool water or drinks left in the trunk of a car or in the bus makes a delightful treat at the end of a hike. **NOTE:** Should a student complain about a headache, make sure that he or she drinks more water. Dehydration is one of the first stages in the process of the body overheating, which can become a life-threatening condition. Plan regular breaks for the class to drink their water!

Do carry plenty of food and snacks. These will help keep the group's energy up during the hike, and make it easier for the group to travel as a unit.

Do dress appropriately for the changing weather conditions found in the backcountry. Remember that little cloud on the horizon an hour ago? It may now look large, dark, and ominous.

Carry layers of clothes to cope with wind, rain, sun, and even a night out in the canyons. Temperatures can fluctuate dramatically within the canyons. Plan ahead.

Do wear good walking shoes. Sturdy footwear is essential when hiking in areas with cactus, loose, and slick rock. You will enjoy your time far more if you don't have your mind on your feet. Sandals, open-toed shoes, flip-flops, platform, or party shoes, etc. are not appropriate.

Do the Right Thing
Using Good Manners in the Out-of-Doors

BACKGROUND FOR **TEACHERS**

Do bring a hat and sunscreen, no matter what the season. Not only do hats keep you warm in cold weather, but they help shade and cool you in the heat. Even a sunny winter day can leave you painfully sunburned if you forget your sunscreen lotion.

Do not walk on cryptobiotic soil crusts. For more information on these fragile but vitally important soils, see p. 73 in the Plant Section. If you must go off trail, keep your group single file, and have them step in each others' footsteps to avoid trampling and destroying large areas of crust. Better yet, try to stay on rocks or hike in dry washes. Keep these fragile areas in mind when choosing a campsite as well.

Do not urinate or defecate close to water, and avoid areas of public use. No matter how many times you remind students to "go before we leave", invariably some people will have to urinate or defecate while on your hike. It is best to discuss methods of waste disposal prior to the event. This can be done in the classroom several days before the field trip. While no one really wants to discuss this topic, as more and more people use the monument, its importance grows.

Urination: Since urine is more sterile, stepping behind a bush or rock outcrop is permissible. However, do not go near any kind of water source or public thoroughfare. Students should also avoid trampling cryptobiotic soil crust, and they should be alert for cactus and other wildlife like spiders, scorpions, and snakes whose homes may be nearby.

Defecation: As feces carries disease, more care must be taken to dispose of it. First, it is very important that you keep a minimum of 100 yards away from areas that contain or drain water, as you do not want to further the spread of *Giardia*. Second, dig a hole six to eight inches deep with the heel of your boot or with a rock or stick that you find on the ground. Deposit waste in the hole and cover it completely with the soil from the hole. Restore the surface of the area so that your presence is undetectable.

Disposing of toilet paper and sanitary products: This is why reclosable plastic bags are in the teacher's backpack. When a student needs to defecate, the pack of bags and toilet paper can go out with them. Students can seal toilet paper and sanitary products in one of the small plastic bags, which can then be carried out with the group for proper disposal at a later time. This method eliminates both the unsightly white wads of paper found too often along trails, and assures better hygiene for all.

In Case of an Emergency

Rarely does something go wrong on a field trip. The opportunity to be outside exploring a beautiful place seems to work like a magic charm on students. This is a special time, and they know it. However, one can never be too prepared. To have anticipated a problem, and have the ability or materials to take care of it, can make a great day even better. Thus, taking the time to get the following items ready, discussing appropriate behaviors, and getting good parental support can make a big difference. Below are some options for handling difficult situations, and a list of useful items that will impress your students, and have you "ready for anything"!

The Teacher's Ready-For-Anything-So-Nothing- Will-Happen Kit

- ☐ Good backpack with sturdy straps
- ☐ Your filled water bottle
- ☐ Your lunch and snacks
- ☐ First aid kit with tweezers for cactus spines
- ☐ 4 - 6 trash bags (for anything from an instant rain jacket to trash pick up to a seat on wet ground)
- ☐ 2 warm hats (for the students who never remember their jackets and need to)
- ☐ 1 extra lunch (for the student who thought they had it but doesn't)
- ☐ Extra water bottle (for the friend of the student without a lunch)
- ☐ Sunscreen lotion (because someone always forgets theirs)
- ☐ 3 - 4 packages of life savers or hard candies (for incentives in that last long mile — or to fill time)
- ☐ Pocket knife
- ☐ Matches
- ☐ Map of Colorado National Monument
- ☐ Roll of toilet paper and 10 zip lock bags (for when nature calls)
- ☐ Bandana (for wetting and wearing around your neck to cool you off on a hot day)
- ☐ Rain jacket (because you never know about those pesky clouds way off in the distance)
- ☐ Sweater, vest or other warm clothes (because someone might get cold)
- ☐ List of students in class and their emergency numbers to call
- ☐ Telephone number of the school/bus company
- ☐ Your lesson plan/outline for the day
- ☐ Flashlight and extra batteries

In Case of an Emergency

If it looks like rain, bring along large sized plastic trash bags. Figure one per student plus a few extras for good measure. With a hole cut in the bottom, and two small ones in the sides, trash bags make excellent emergency rain jackets. If you are camping, have students line their backpacks with them to keep clothes and socks dry inside.

A portable cellular phone may not work in this area because of the canyons. However, one should be taken along.

If a bus or car breaks down: Above all, make sure that the vehicle is going to be safe where it is. If you are on the road, turn on flashers, and use flares or reflective triangles to alert drivers of your location. Place a flare at least 100 feet behind the vehicle, and one similarly in front. If you are near a hill or curve, use extra caution and place a flare 500 feet away from the vehicle to alert oncoming drivers. Survey the scene. Can the bus/car be seen well in advance in both directions on the road? Be conservative, and send a parent out behind the bus, and another out in front, to notify other drivers. Observe the situation on and around the road. Is it going to be more safe for the students in or out of the bus? Unless you feel certain of their safety being greater OUT of the bus, keep the students inside. If they need to get out, consider where they can safely congregate. Are there cliffs or dangerous places nearby? Can they move around or sit without being in danger? What is the weather like? Is there shade if it is hot, shelter if it is windy or cold, and no sign of lightning for miles? (Get out your lifesavers!)

Next, look for a National Park Service vehicle and ask them to call for assistance. If no staff appears, flag down a passing car. Your best luck will be with a vehicle with local license plates, which will be more likely to travel without stops to a telephone. Give them the number(s) you want called in writing, so that they will remember. Be sure to write down the exact location of the bus, so that assistance can come from the closest direction (Fruita or Grand Junction).

If a car in your car pool does not show up at the trailhead: Make a plan in advance to deal with this situation. An easy way to be sure that each driver has all the information that they would need is to copy the map and directions on one side of a piece of paper, and a list of students, emergency numbers, the school telephone number, and the Colorado National Monument number on the back side. Then, set up an agreed upon meeting place and time. Wait 15 minutes past that time before proceeding along the trail. Leave a note on the windshield of your vehicle stating your plans and what time you left. If you go slowly at first, you can give the group that is delayed an extra opportunity to catch up. Have an understanding that if an hour or more delay occurs for a vehicle, the driver should not try to catch up with the group. Rather, the driver should return the students to the school.

If an injury occurs to a student or a parent: Once more, a plan in advance is helpful. Choosing your chaperones/drivers with their skills in mind can make a big difference in a real emergency. If someone has medical training, or knows first aid, you should know this beforehand. Explain to them that you will look to that person for assistance should an emergency occur. In addition, you should know if anyone coming on the trip has an existing medical condition, such as diabetes or an allergy to bees.

In Case of an Emergency

If your group will be traveling as a unit, then one first aid kit is adequate for all. However if you are hiking in smaller groups, then each group should have its own first aid kit. Time can be of the essence in an emergency, thus safety predicates that you have plenty of supplies with you.

If an accident occurs, have the group stop and sit down immediately. Do not crowd around the victim as this can be more frightening for all parties. Take charge at once. Determine what the mechanism of injury is, and if you can safely approach the victim. (For example, if a rattlesnake is nearby, do not jeopardize yourself or others by attending to the victim. Loose rocks, cliffs, or rock slides are other situations to evaluate very carefully before proceeding.) Ask a parent to stay with, and be in charge of, the other students. Tell your students that they will get full details as soon as you can get them. Lack of information is a source of great anxiety to children. They need and want to know what is happening.

Stabilize the victim using Red Cross First Aid procedures, or follow the directions of the medical personnel with you. Always check for Airway, Breathing, and Circulation (A, B, C's). If the victim is conscious and breathing, attempt to determine the extent of their injuries by giving a head-to-toe evaluation. Ask lots of questions as you do this. You do not want to cause more problems by overlooking something. If it appears that the victim can be treated on site, use the first aid kit to deal with the injury. If it is hot, shade the victim as best you can. If it is cold, be sure to keep the victim warm by placing a jacket around them. Ask other student(s) to carry the pack of the injured student. If it appears that the student can proceed after treatment on-site, evaluate whether it is better to continue towards your destination or return to the trailhead. Do not divide the group up unless it appears to be safe for all parties to do so. If the group is divided, you will have to decide whom to accompany: the victim or the rest of the group. If this decision is difficult to make, then everyone should go out together. The class can return another time.

Should greater medical help than you can give on-site be necessary, or the victim not be able to get back to the trailhead on his/her own, send a parent out for help. The teacher must stay with the group — and the victim. Remember that it will take some time for assistance to arrive. Therefore, do the following things.

1) Stabilize the victim as best you can. Shock is a real concern in an emergency, so keep the victim warm by placing jackets under and over the person. Have an adult watch the victim for changes in their condition including breathing, consciousness, skin color, and nausea.

2) If the victim is conscious and alert, she or he may appreciate having a friend stay with them, as well as an adult. Ask the victim if they would like to choose someone to be with them, and if so, whom.

In turn, quietly ask the friend if they would like to help out. Be upfront about what is happening to be sure the friend is really ready to get involved.

3) Take some time to discuss with the rest of the group what has happened and what the plan to deal with it is. They will be more cooperative, and less worried and restless if they know what is going on. Even if you do not know exactly how long things will take, or what will happen, be honest about it. Your students trust and depend on you. They will help out when you give them something to do. For example, on a cold day, they can seek out a more sheltered area to wait. On a hot day, send them to find some shade. Remind them of how important it is for them to take care of themselves and one another by drinking water, eating the food they brought, and staying together as a group. If it seems appropriate, give them an assignment to accomplish.

In Case of an Emergency

4) Make notes about what happened, and how the situation was handled. The pencil and paper in the first aid kit are for this purpose. They will be very handy when filling out all the paperwork later. Alternatively, ask a parent to record information that you dictate to them.

Where to find the Colorado National Monument staff: Before going for help from the monument staff, consider where you are located, what kind of help is needed, and how long it will take to get to cars, the road, or a phone. Searching out National Park Service staff might waste valuable time. Getting to a phone and calling 911 may be the fastest and best alternative.

Colorado National Monument staff may be found at five different locations in the monument.

1) Park Rangers patrol Rim Rock Drive several times each day. Look for a white sedan or pickup truck with National Park Service insignia on the side.

2) The East (Grand Junction) and West (Fruita) Entrance Stations at either end of Rim Rock Drive are staffed from late April until the end of September. Radio and telephone assistance will be available there.

3) Staff are on duty at the Visitor Center from 9:00 AM to 5:00 PM every day except December 25th.

4) Monument staff may also be found in the Service or Maintenance Yard during business hours. The Yard is about one-quarter mile away from Headquarters as you head toward Fruita. Look for a paved road on your left (as you go downhill from Headquarters) or on your right when coming up the hill.

5) Some employees live on site. If you have a late night emergency, follow the service road past the Maintenance Yard to a housing area. Contact one of the residents for assistance if necessary.

Public telephones may be found at Monument Headquarters.

A Note to Teachers, Administrators, and Parents

Because this information is given does not in the least bit imply that a visit to Colorado National Monument is risky. Colorado National Monument is a spectacular and unique place, and one that you are lucky enough to have nearby. However, in this era of legal action and high costs, and in a time when the National Park Service budgets do not permit staffing to guide groups on the trails, being as thorough in planning as possible is a worthwhile investment of time. The actions and information in this section are to give you as many options as possible to work with, so that quick decisions can be made to assure the safety of the group, as well as the resource. It is in everyone's interest that a field trip go smoothly and enjoyably. Proper preparations are key to the success of a trip, but that does not mean you will use everything that you have planned for. As was stated at the beginning, being on a field trip seems to work like a lucky charm on students, and all goes well.

CHAPTER TWO

Plant Life

of Colorado National Monument

Photo from *Through the Eyes of the Children*
by Diane Hirschinger Gallegos and Tope Elementary Students

Plants of Colorado National Monument

BACKGROUND FOR **TEACHERS**

The mesa tops, ridges, cliffs, talus slopes, canyon bottoms, sagebrush flats, riparian corridors, creek beds, and clay soils of Colorado National Monument create diverse and challenging environments for plants. The cold winters and hot, dry summers mean that plants must be sturdy and adaptable in order to survive. Listed below are some of the more common plants, shrubs, and trees that may be seen on a field trip. They are listed in alphabetical order, not in order of their occurrence or quantity. The common name is located in the left column, and the scientific name is shown in italics in the right column.

Trees

Box elder	*Negundo aceroides*
Canyon cottonwood	*Populus deltoides ssp. wislizenii*
Douglas fir	*Pseudotsuga menziesii*
Gambel oak	*Quercus gambelli*
Narrow leaf cottonwood	*Populus angustifolia*
Pinyon pine	*Pinus edulis*
Ponderosa pine	*Pinus ponderosa*
Sandbar willow	*Salix eigua* or *Salix interior*
Singleleaf ash	*Fraxinus anomala*
Tamarisk	*Tamarix ramosissima*
Utah juniper	*Juniperus osteosperma*

Shrubs

Big sagebrush	*Artemesia tridentata*
Black sagebrush	*Artemesia nova*
Cliffrose	*Cowania mexicana*
Fendlerbush	*Fendlera rupicula*
Four-winged saltbush	*Atriplex canescens*
Greasewood	*Sarcobatus vermiculatus*
Mormon tea	*Ephedra torreyana* or *Ephedra viridis*
Mountain mahogany	*Cerocarpus ledifolius and hybrids*
Rabbitbrush	*Chrysothamnus nauseousus*
Serviceberry	*Amelanchier utahensis*
Snowberry	*Symphoricarpos oreophilus*
Spiny sagebrush	*Artemesia spinescens*
Wild rose	*Rosa woodsii*

Plants of Colorado National Monument

BACKGROUND FOR **TEACHERS**

Cactus

Barrel cactus	
Claret cup cactus (hedgehog group)	*Echinocereus triglochidiatus*
Fishhook cactus	*Sclerocactus parviflorus*
Prickly pear (pads flat)	*Opuntia erinacea*
Prickly pear (pads potato-like)	*Opuntia fragilisGrass*
Galleta grass	*Hilaria jamesii*
Indian ricegrass	*Oryzopsis hymenoides*
Needle and thread grass	*Stipa comata*
Cheatgrass	*Bromus tectorum*

Flowering Plants (Pink, Red and Organge)

Annual gilia	*Gilia sinuata* or *Gilia leptomeria*
Bull thistle	*Circium vulgare*
Claret cup cactus	*Echinocereus triglochidiatus*
Copper globemallow	*Sphaeralcea coccinea ssp. dissecta*
Cranesbill/Wild geranium	*Erodium cicutarium*
Fishhook cactus	*Sclerocactus parviflorus*
Indian paintbrush	*Castilleja chromosa*
Longleaf phlox	*Phlox longifolia*
Prickly pear cactus	*Opuntia sp.*
Showy milkweed	*Asclepias speciosa*
Wallflower	*Erysimum capitatum*
Wild onion	*Allium acuminatum*
Wild rose	*Rosa woodsii*
Wirelettuce	*Stephanomeria tenuifolia*

Flowering Plants (Purple and Blue)

Bilobe larkspur	*Delphinium nuttallianum*
Bluestem penstemon	*Penstemon cyanocaulis*
Branching daisy/Fleabane	*Erigeron divergens*
Colorado four o'clock	*Mirabilis multiflora*
Common vetch	*Vicia americana*
Dusty penstemon	*Penstemon comarrhenus*
Mat verbena	*Verbena bracteata*
Pacific aster	*Aster chilensis*
Silvery lupine	*Lupinus argentus*
Tansy aster	*Machaeranthera canescens*
Utah daisy	*Erigeron utahensis*
Wild blue flax	*Linum lewissii*

Plants of Colorado National Monument

Flowering Plants (White to Cream)

Aster	*Aster falcatus*
Bindweed	*Convolvulus arvensis*
Cryptantha or white borage	*Cryptantha crassisepala*
Datil yucca	*Yucca baccata*
Desert evening primrose	*Oenothera caespitosa*
Desert pepperweed	*Lepidium densiflorum*
Fragrant sandverbena	*Abronia fragrans*
Hoary townsendia	*Townsendia incana*
Mountain pepperweed	*Lepidium montanum*
Rattleweed milkvetch	*Astragalus praelongus*
Sego lily	*Calochortus nuttallii*
Spreading fleabane	*Erigeron divergens*

Flowering Plants (Yellow)

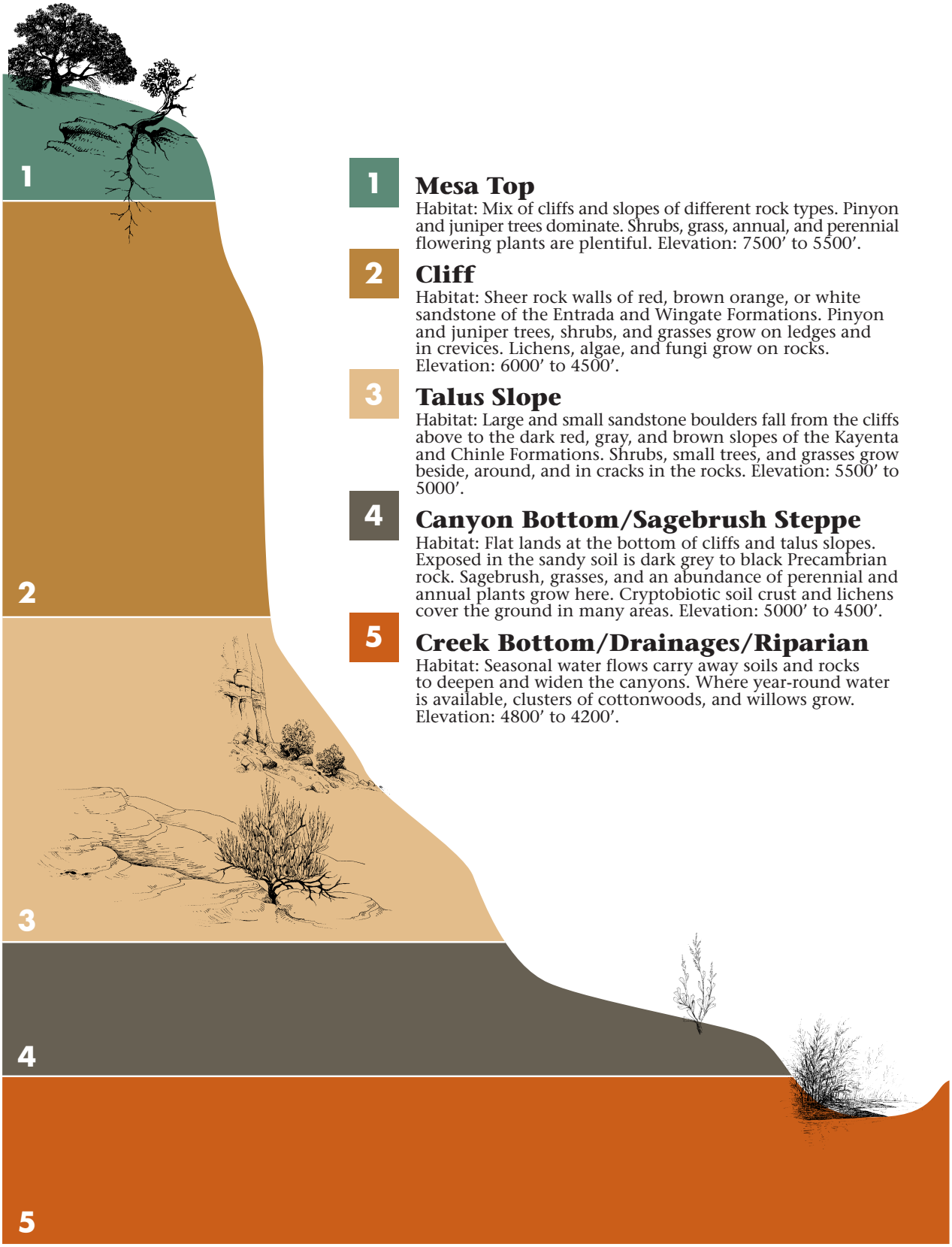
Actinea or Perky Sue	*Actinea acanlis*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Butter and eggs	*Linaria vulgaris*
Common dandelion	*Taraxacum officinale*
Common sunflower	*Helianthus annuus*
Cream tips	*Hymenopappus filifolius*
Desert trumpet	*Eriogonum inflatum*
Few flowered goldenrod	*Solidago sparsiflora*
Gaillardia/Blanket flower	*Gaillardia pinnatifida*
Golden aster	*Heterotheca horrida*
Gumweed	*Grindellia squarrosa*
Mullein	*Verbascum thapsus*
Prickly pear	*Opuntia phaecantha*
Prince's plume	*Stanleya pinnata*
Puccoon	*Lithospermum incisum*
Rabbitbrush	*Chrysothamnus nauseosus*
Senecio or Groundsel	*Senecio mulicapitatus*
Salsify	*Tagopogon dubius*
Stonecrop	*Sedum lanceolatum*
Streptanthus or Jewel flower	*Streptanthus cordata*
Tansy mustard	*Descurainia pinnata*
Twin bladder pod	*Physaria acutifolia*
Yellow borage	*Cryptantha flava*
Yellow sweet clover	*Melilotus officinalis*
Wallflower	*Erysimum asperum*

Flowering Plants (Green)

Sagebrush	*Artemesia tridentata*
Grass family	*Gramineae*

Land Forms and Life Zones
of Colorado National Monument

BACKGROUND FOR **TEACHERS**



1 Mesa Top
Habitat: Mix of cliffs and slopes of different rock types. Pinyon and juniper trees dominate. Shrubs, grass, annual, and perennial flowering plants are plentiful. Elevation: 7500’ to 5500’.

2 Cliff
Habitat: Sheer rock walls of red, brown orange, or white sandstone of the Entrada and Wingate Formations. Pinyon and juniper trees, shrubs, and grasses grow on ledges and in crevices. Lichens, algae, and fungi grow on rocks. Elevation: 6000’ to 4500’.

3 Talus Slope
Habitat: Large and small sandstone boulders fall from the cliffs above to the dark red, gray, and brown slopes of the Kayenta and Chinle Formations. Shrubs, small trees, and grasses grow beside, around, and in cracks in the rocks. Elevation: 5500’ to 5000’.

4 Canyon Bottom/Sagebrush Steppe
Habitat: Flat lands at the bottom of cliffs and talus slopes. Exposed in the sandy soil is dark grey to black Precambrian rock. Sagebrush, grasses, and an abundance of perennial and annual plants grow here. Cryptobiotic soil crust and lichens cover the ground in many areas. Elevation: 5000’ to 4500’.

5 Creek Bottom/Drainages/Riparian
Habitat: Seasonal water flows carry away soils and rocks to deepen and widen the canyons. Where year-round water is available, clusters of cottonwoods, and willows grow. Elevation: 4800’ to 4200’.

Tips for Plant Watchers

1 Plants can be a source of wonder and amazement for children as well as adults. Yet because we are seldom conscious of them in daily life, our connections to them have dwindled. We live in cities where pavement and buildings rise in place of trees and plants. Our food and clothing comes from stores instead of crops and animals that we grow. A trip to Colorado National Monument offers a memorable opportunity to rediscover our "roots." The keys to interesting children in plants lie in an adequate amount of time to explore, and in an attitude of appreciation and marvel by the leader. Enthusiasm and curiosity are contagious, no matter what the subject.

2 The leader should feel comfortable with the subject matter and the setting. Trying to figure out which way to go at the same time as trying to locate interesting plants will cause tension for both the leader and the class. As a result, the students will be more disruptive and hard to handle. Therefore, take time to review background information, make notes, and preview the area.

3 Visit the trail that will be used for the field trip ahead of time, and as close to the date of the trip as possible. Flowers are ephemeral, and do not last long. Two weeks later, the beautiful cliffrose will no longer be blooming. Nor will the fifteen species that you painstakingly keyed out. Thus, plan your exploration with students as close as possible to your preview of the trail.

4 Structure the hike to coincide with students' rhythms. If they are at their most energetic in the morning, have the moving part of the trip early. To ask them to walk slowly and observe, when they are straining to get out and go, will cause trouble for everyone. After lunch and snacks are natural times for reflecting, observing, and conducting quieter activities.

5 Not all people are inclined towards plants. The interest and enthusiasm of the leader will draw in some students, but many will still need help. If you can anticipate who these children are, pair them with a chaperone who can give them individual attention and encouragement. Planning a few special activities for these students can also make a big difference.

For example, many people like plants but have more active ways of exploring their environment. For them, "jobs" can be created to keep them interested, alert, and involved. These may be given verbally, or a task card with the assignment can be developed. Below is a list of possible jobs.

~ Assign students to be "scouts" for certain plants. One looks for cactus, while another lets you know when you pass a Sego lily or Indian paintbrush. You may want to allow these scouts to go at the front of the line, and report back their discoveries.

~ A second option is to designate "counters" to keep track of the number of bees and wasps that are located at flowers along the way. "Counters" can keep a list of all the plants that are found, record the number of plants that are in seed, in bloom, or are dead, throughout the trip.

Tips for Plant Watchers

- A third option for the active learner is the role of "defenders" of the cryptobiotic soil crust. They let you know when it is nearby, and help keep students on the trail.
- Still other students can be "trackers", finding signs of animals' use of plants and trees.
- A student who likes field guides can be the "informer", carrying the guide and looking things up.
- For the most active students, the role of the "litter bug" can be created. This student carries the trash bag and collects litter along the route.

6 Make linkages between plants and other aspects of the environment. If students learn about how juniper trees are pioneers for growth in new environments, then they may appreciate the junipers in their own yards a bit more. If they see a broken-off cactus pad or a loose cactus fruit, they will think of it as food for a pack rat later that night. Creating an appreciation for and understanding that plants are essential elements in the web of life is a valuable goal for any field trip.

7 Plant names are important and useful terms for describing, classifying, and recollecting. However, the value of the plant lies not in its identification, but in its function and place in the environment. As the leader, you do not have to be a scholarly botanist. Children's interest in names is not nearly as great as their curiosity about leaf hairs, cones, flowers, and cactus pads and spines. Encourage them to invent their own plant names based on features of the plants that they observe. Then compare what they give to what scientists have given. If you are familiar with scientific names of plants, you may want to include these too. As the roots of so many plant names derive from Latin or Greek, a follow-up lesson with dictionaries might be of interest.

Several books about the derivations of plant names are also available. See the bibliography section for more information.

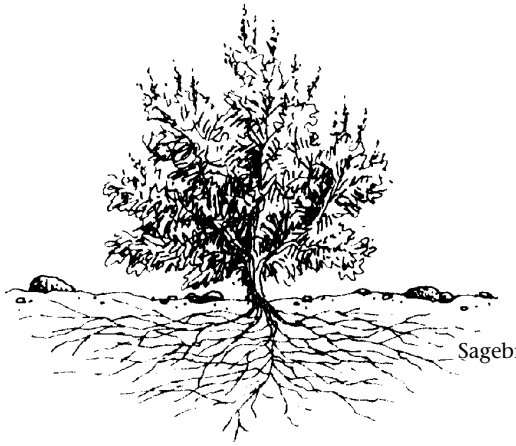
Plant Adaptations to the Environment

BACKGROUND FOR **TEACHERS**

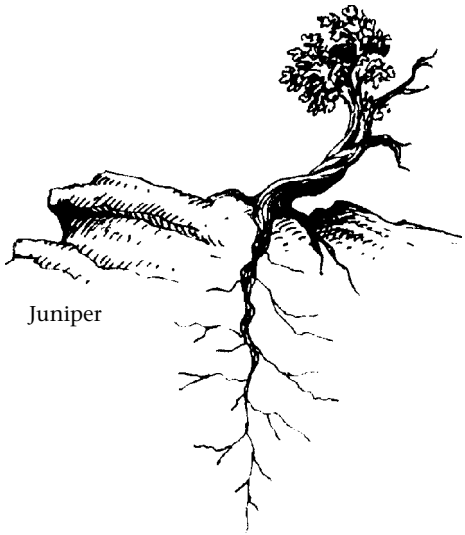
Plants are in a state of continual change. Between the flux of seasons and the resulting periods of growth and dormancy, plants must complete their cycle of life in a short period of time to assure survival. In an environment like that of the Grand Valley, where only 6 to 12 inches of moisture are received each year, plants face additional challenges. The first is to get enough water to survive. The second is to preserve what water they can. The third is to protect themselves against heating up and drying out. To cope with these obstacles, plants have developed many fascinating and unique features.

To appreciate what plants must contend with, look first at what humans carry with them when going on a hike or camping trip. Water, food, shelter, rain gear, jacket, hat, sunscreen, hiking boots are among the essentials that we need. What, then, do plants do in the same setting? Numerous adaptations help each one to prevail. Below are some of the strategies that plants and plant families utilize to assure reproduction and survival.

How plants get water



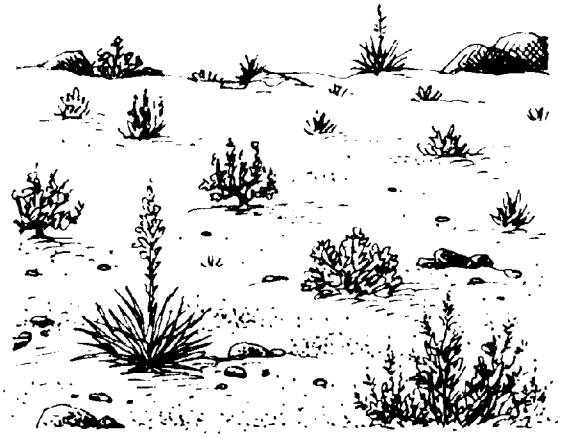
1 Extensive, shallow root systems spread far beyond the plant itself. If only a small amount of rain falls, these widespreading roots absorb as much as is available for the plant. *Examples: Sagebrush and cactus.*



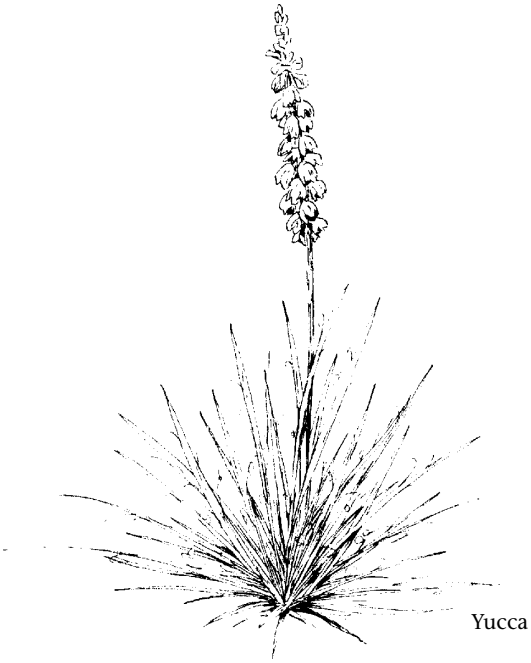
2 Long tap roots reach deep in the soil to bring underground moisture to the plant. *Example: Juniper.*

Plant Adaptations to the Environment

BACKGROUND FOR **TEACHERS**

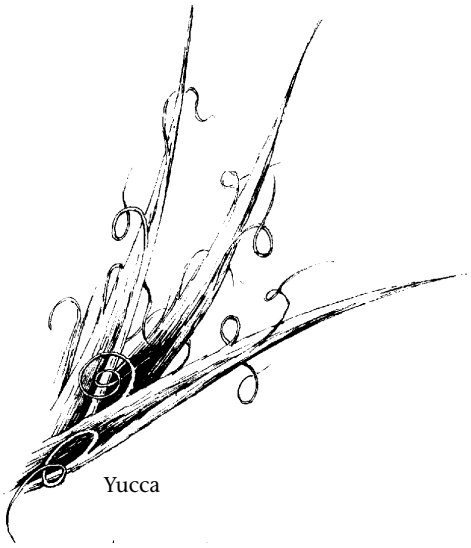


3 Plants are widely spaced. This reduces competition between plants for water, nutrients, and other scarce resources. Some plants even concentrate resins, minerals, and other compounds in the soil surrounding them to make it difficult for other plants to grow nearby.
Examples: Sagebrush, pinyon, and juniper.



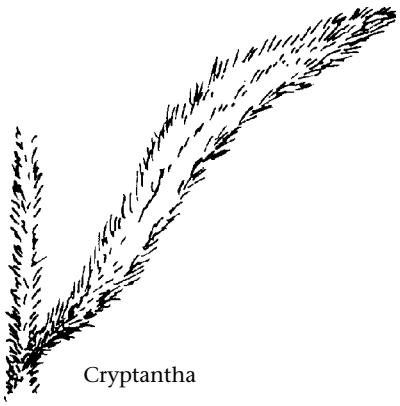
Yucca

4 Leaves grow in a rosette or whorl shape to direct any moisture collected to the center of the plant.
Examples: Yucca and buckwheat families.



Yucca

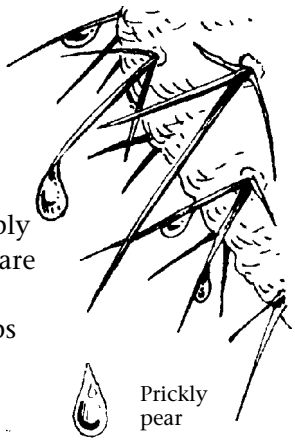
5 Leaf edges curl up or inward to act as a reservoir for any available moisture.
Examples: Yucca, primrose, and grass families.



Cryptantha

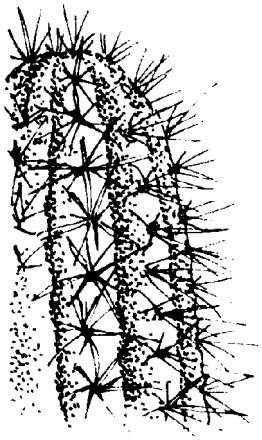
6 Tiny hairs cover the surface of the leaf and/or stem. This increases surface area from which the plant can capture moisture from the air.
Examples: Indian paintbrush, globemallow, and borage family.

Plant Adaptations to the Environment



Prickly pear

7 Spines and sharply pointed leaf tips are oriented downwards to drain dew and raindrops towards the soil below.
Example: Prickly pear cactus.



Hedgehog

8 The stem is wavy or fluted so that water and dew can be channeled to the base of the plant.
Example: Hedgehog cactus.

Indian paintbrush

9 Plants grow as parasites on other plants, getting their moisture and nutrients from the other plant.
Examples: Indian paintbrush and mistletoe on juniper trees.

10 Plants grow in areas where a black crust grows in the soil. Known as cryptobiotic soil crust, the blackened areas are actually a patchwork of tiny filaments of fungus, algae, lichen, and moss that penetrate the soil to aerate, open up, and increase soil volume. They also aid in retention of water, and decompose into valuable soil nutrients and organic material. Seeds and plants growing in such places benefit from association with the soil crust.
Example: Pea Family.

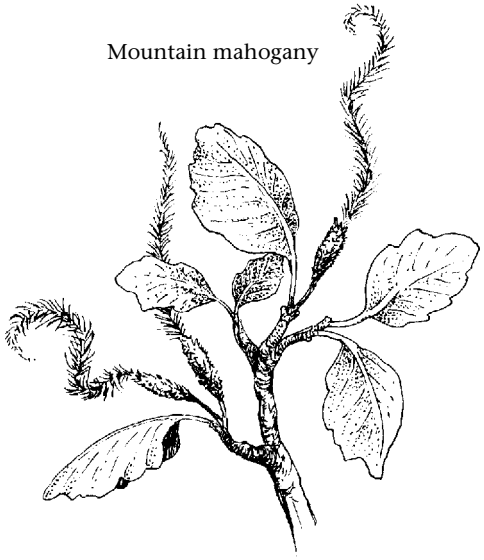
Plant Adaptations to the Environment

BACKGROUND FOR **TEACHERS**

How plants keep water

Rabbitbrush

1 Surface area of leaves is reduced so less water is lost from transpiration and overheating. Many plants have narrow leaves, such as *rabbitbrush, composite, buckwheat,* and *mustard families*. Others are deeply dissected leaves: *geranium and delphinium families*.



Mountain mahogany

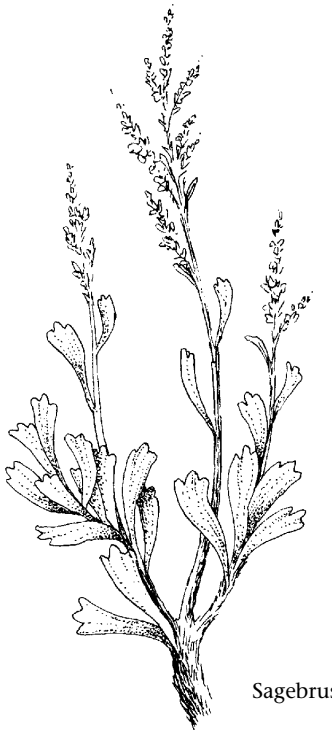
alderleaf in fruit

curlleaf in fruit

2 Leaves are reduced in size compared to leaves of plants growing in wetter environments: *composite family* and *pine trees*. Leaves roll or curl under to be smaller: *mountain mahogany.* These strategies for survival reduce surface area from which moisture can be lost, thereby conserving precious water.

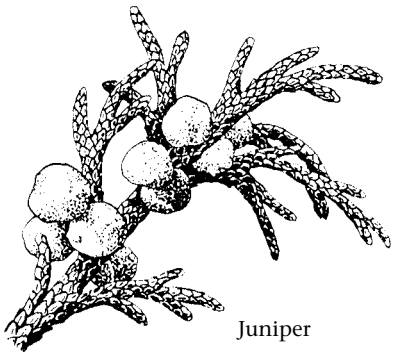
Plant Adaptations to the Environment

BACKGROUND FOR **TEACHERS**



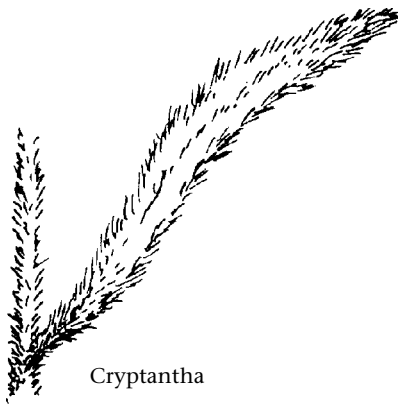
Sagebrush

3 Leaves drop off and/or the plant goes dormant during especially dry seasons: *sagebrush, creosote bush*. The pads drop off during dry seasons, and new ones grow once rains begin again: *prickly pear cactus*.



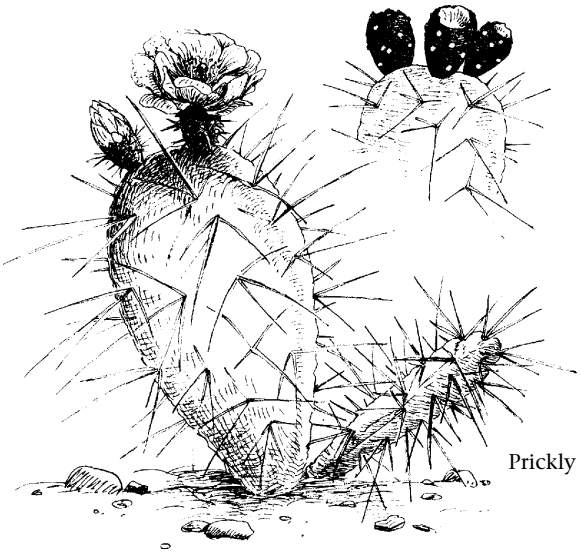
Juniper

4 Leaves are tiny scales on the branch *(juniper and tamarisk)*, or dry out soon after appearing *(Mormon tea)*. *Prickly pear cactus* also have small scales at the joints that grow only for the first few years.



Cryptantha

5 Leaves are covered with tiny hairs that reduce heat by reflecting away light, and cool the plant as air passes over them. The result is less water loss and improved survival. *Examples: Indian paintbrush, globe mallow, sagebrush, cliffrose, willow.*



Prickly pear

6 Leaves are coated with a waxy substance, called cutin, that keeps water in and reflects away heat.
Example: Cactus family.

Plant Adaptations to the Environment

7 The pores on leaves open at night instead of during the day as a way of keeping moisture in the plant. Blossoms open in the evening or early morning, and close up during the heat of the day.
Examples: Four o' clock family, evening primrose family.

8 Leaves or stem are succulent, fleshy and thick, thanks to water storage tissues inside which retain water even when it is dry.
Examples: Cactus and greasewood families.

9 Internal leaf structures enable leaves to dry out entirely, yet recover as soon as rain begin.
Examples: Lichen and fungus.

10 Some plants have physical structures that act as reservoirs to hold water. Many swell up during rains, and wither as water is used up.
Examples: Desert trumpets, bladderpods, and cactus.

How plants protect themselves from heat and harsh conditions

1 Flowers bloom quickly, or in one day. The blossom happens before, or as, the leaves are coming out. The entire life cycle of the plant takes place during times of moisture, and the plant survives dry seasons as a seed. This leads to cycles of wildflower blooming, where wet years are spectacular, and dry ones are minimal. A second blooming of some species occurs when late summer rains trigger seeds to sprout and flowers to bloom.
Examples: Many annuals, including the evening primrose, lily and grass families, utilize this strategy for survival.

2 Hairs and spines act to shade the plant from the ultraviolet rays and heat of the sun. They also reflect light away. Plants have a greenish-gray to white color on leaves and stem.
Examples: Cactus, bladderpods, globemallow.

Mormon tea

3 Plant has no leaves at all, and instead, photosynthesis takes place in the stem.
Examples: Mormon tea and cactus.

4 Many seedlings and young trees get shade and shelter from something else until they are large enough and strong enough to survive independently. *Pinyon pines* follow pioneering *juniper* trees into new areas. Young trees grow under old ones.

5 Plants orient leaves to point upward vertically to the sun so that a minimum of surface area is exposed to the heat. *Example: Mountain mahogany*. Plant leaves droop with the same effect.
Example: Willow.

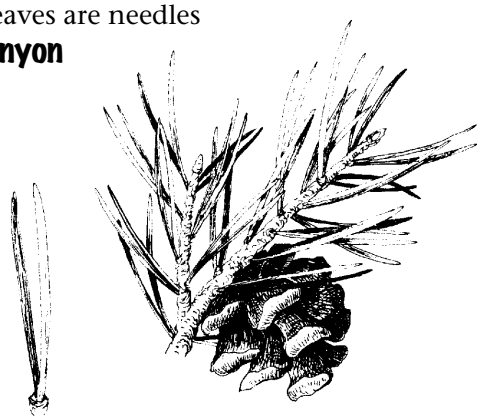
Plant Terminology

BACKGROUND FOR **TEACHERS**

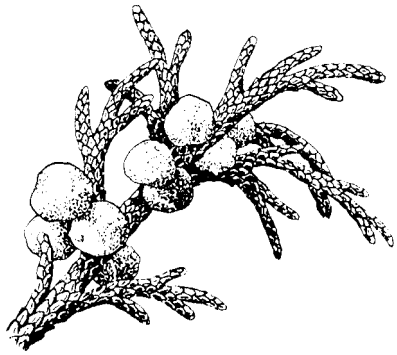
On a field trip, students will ask, "What's this plant?" You do not have to be a botanist to answer their questions, but some background in plant identification is helpful. While botany is the study of plants, a division within it is known as "taxonomy". It is the study of how plants (and animals) are classified, based on a systematic arrangement into categories. Because many details combine to distinguish plant species, attention must be paid to all parts. The following terms will help you match up an unknown plant with information in a field guide to decide "what that plant is."

Kinds of Leaves

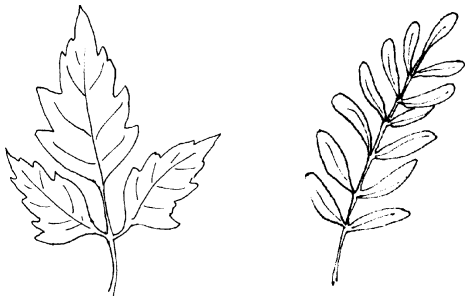
Leaves are needles
Pinyon



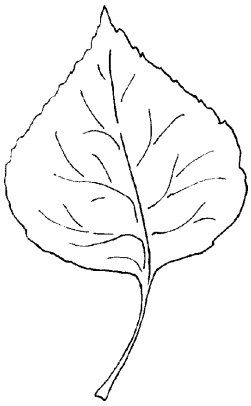
Leaves are scales
Juniper



Leaves are compound
Legume (Pea) Family
(many smaller leaflets come off a single stem)

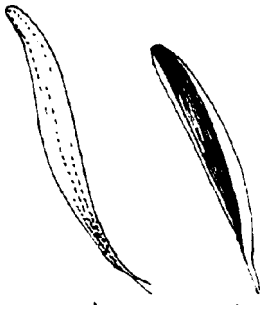


Leaves are simple
Singleleaf Ash and many other plants
(single leaf on a stem, unbranched)



Plant Terminology

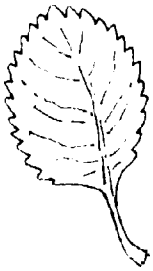
Leaves are linear
Rabbitbrush
(longer than they are wide)



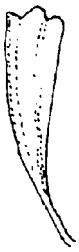
Leaves are lance-shaped (lanceolate)
Yucca

Leaves are oval to ovate
Cottonwood

Leaves are toothed
Mountain Mahogany
(small indentations along the leaf edge)



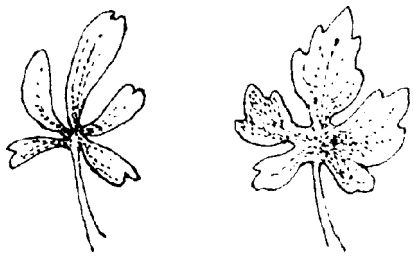
Leaves are wedge-shaped (cuneate)
Sagebrush



Leaves are lobed
Oak Family
(edges are indented like scallops)

Plant Terminology

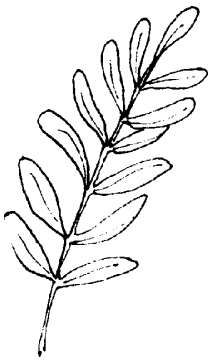
Leaves are dissected
Globemallow
(deeper indentations that may nearly divide the leaf)



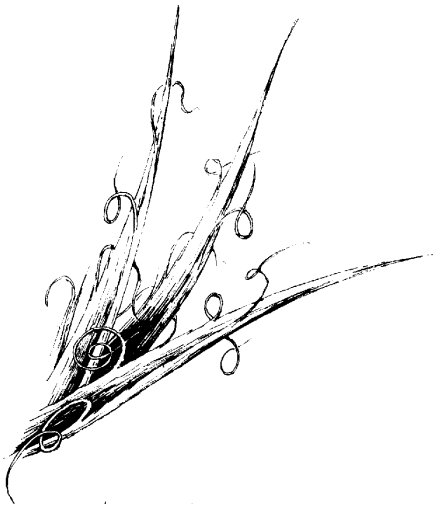
Leaf veins are parallel
Lily Family
(all veins travel in the same direction)

Leaves are arranged alternately on the stem
Indian Paintbrush and many others

Leaves are arranged opposite each other
Legume (Pea) Family and many others on the stem



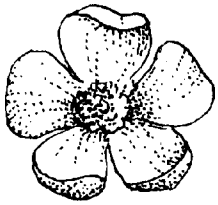
Leaves are arranged in a whorl
Narrowleaf Yucca
(circular fashion around a single stem)



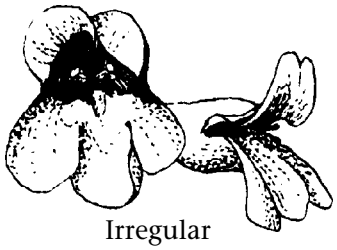
Plant Terminology

Flower Terms

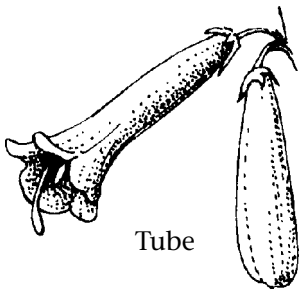
Flower shape



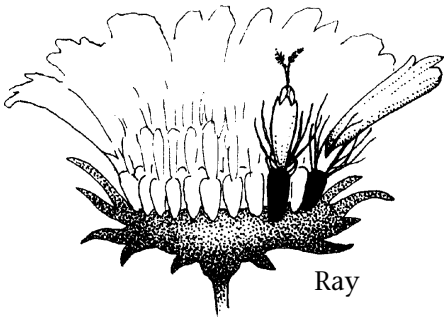
Regular



Irregular



Tube



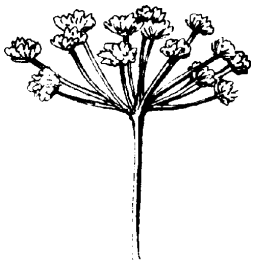
Ray

Arrangement of flowers on stalk

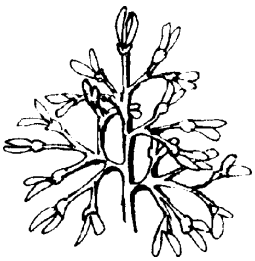
Solitary

Raceme

Spike



Umbel



Panicle

Plant Terminology

ACTIVITIES FOR STUDENTS

Flower Terms

This area is for drawing flower shapes and arrangements of flowers on stalks.

Flower shape

Regular

Irregular

Tube

Ray

Arrangement of flowers on stalk

Solitary

Raceme

Spike

Umbel

Panicle

The Value of Magnification

BACKGROUND FOR **TEACHERS**

When studying plants in the field, whether it be the tiny mosses and lichens of cryptobiotic soil crust, the needles of a pinyon tree, or the hairs on the underside of a mountain mahogany leaf, a magnifying glass or hand lens is invaluable. An entirely new world opens up to students when a leaf is enlarged to show waxy epidermis, stomata, and tomentum. The true meaning of composite flower, and the remarkable adaptations of lichens to lack of water, can be appreciated. You do not need the fancy lens loupes of botanists. A five to ten-power magnification works well for students. If the school provides these, take them on your field trip. If not, a purchase may be worthwhile. Local discount stores, art suppliers, even toy stores may carry them. Alternatively, science distributors (NASCO or Carolina Biological Supply) should have them. Lastly, never underestimate the desk drawers, closets, and sewing boxes of your students and parents.

A word of caution

Every group has at least one of these…the firestarter. They aren't bad children or pyromaniacs. It is just the chemistry of a magnifier in a hand coupled with a natural curiosity. A clear warning to the group when the lenses are passed out should take care of most problems. "These lenses are your responsibility. Thirty were passed out. Thirty must be returned. You will be responsible for replacing any that are lost. If the teacher or chaperone or other student sees anyone using the magnifier in a dangerous manner, no questions will be asked, and the magnifier will be collected immediately. This is dry country, a national treasure. It must be treated as such."

Botanical Journal

ACTIVITY **PAGE**

Age Level

4th through 8th grades.

Purpose of Activity

The purpose of this activity is to explore the fascinating and diverse world of plants with children. In this activity, they will learn how to identify plants by location and physical features. In addition, they will create a "Botanical Journal" as a record of the plants that they found at Colorado National Monument.

Amount of Time Needed

One to one and one-half hours.

Best Location

The "Journal" can be made at various points along a hike in the Colorado National Monument. Trails like Devils Kitchen, Old Gordon, No Thoroughfare Canyon, Monument Canyon, Black Ridge, Alcove Nature, and Window Rock can all be the focus for the hike. Even on a tour of Rim Rock Drive, this activity works well. However, not all plants listed in this activity will be found on each trail.

Materials Needed

Materials needed include:

- ☐ "Botanical Journal" (one copy of each page per student).
- ☐ Pencil (one each).
- ☐ Colored pencils, craypas, or crayons (not markers). You will need lots of greens, grays, yellows, and browns.
- ☐ Clip board, or hard surface to write on (one each).
- ☐ Blank sheets of paper (for extra drawings or records).
- ☐ Magnifier (optional for younger students).
- ☐ Plant identification book(s).
- ☐ Optional: Make the "Botanical Journal" more informative by including copies of "Plant Terminology", "Plants of Colorado National Monument," "Life Zones," and "Plant Adaptations"
- ☐ Optional: Camera to record interesting plants, or interesting students with plants.

Botanical Journal

ACTIVITY PAGE

Background Information

This activity works well on a day-long hike or overnight outing. It can be used by itself or mixed with other activities, such as "Territories", "Who Lives Here?", and "The Magic of a Drop of Water" and "Floral Investigation". It serves as an excellent conclusion to a study of plants, and will assist the teacher in assessing how much the class has learned. It also complements and involves Educational Content Standards in science.

Review Teacher Information

Before going on a plant hike at Colorado National Monument, review the information given in the Background Information section of this chapter. Many useful concepts about plant survival and adaptation to dryland conditions are outlined. Specifics of plant and flower structure are also shown. Lastly, look through "Tips for Plant Watchers" to assist in planning for students' needs.

Take Time to Explore

Time to inspect and investigate is crucial to the success of the "Botanical Journal". Be sure to allot plenty of time to explore, observe, and record. Everyone will appreciate being able to get their worksheets done, and the time to really observe "their" plants.

No Collecting Policy

Always remember that you are in Colorado National Monument. As a result, NO PLANTS, OR PARTS OF PLANTS, MAY BE COLLECTED. They are an important part of the future of the area. Not only do the plants help to hold and create soil, but they carry in them the seeds of future generations of plants. Taking one, or destroying one, may not seem significant to you. Yet the increasing number of visitors to the area is resulting in a steadily growing impact to the land. One picked flower multiplied hundreds, even thousands, of times means less vegetation — more erosion on the land — less food and shelter for wildlife — more displacement of creatures from their territories — less diversity and beauty for the visitor — more future economic and quality of life deterioration for area residents. It may seem like a little thing to pick a flower, but the consequences extend for a long way.

"Botanical Journal" Worksheets

Following this activity are the "Botanical Journal" worksheets. Twelve plants are described in detail. Included is information on plant features such as leaves, stem, blossom, fruit, and root. Adaptations of the plant to live in the desert-like conditions of the region are also shown. When possible, details on the scientific and common name of the plants are given. Drawing is an important way of learning. A line drawing of each plant will help students to identify it, and "close up views" highlight interesting features.

Botanical Journal

ACTIVITY PAGE

Worksheets also contain an area for personal observation and reflection by students. A section of each page is left blank for them to record in words, or with a sketch, their observations about the plant and its identification. This part of each worksheet can be tailored to meet any special interests of your class. It can also be expanded by the inclusion of extra blank sheets of paper in the "Journal".

Encourage Participation

A word of encouragement: from previous plant activities, the teacher may be acquainted with individuals who are not interested in plants, and can be disruptive for the rest of the group. In anticipation of this situation, the teacher will benefit by reviewing "Tips for Plant Watchers" in the Background Information section. To encourage the participation of wanderers or non-enthusiasts, plan an extra dimension to this exercise: hunting for insects and spiders using plants, or finding signs of bird or animal use of plants or areas around them. These discoveries not only will help the individual student, but all students will become more aware of how crucial vegetation is in the desert web of life.

How to Do the Activity

Before the Field Trip

Before the field trip, the teacher should copy off the "Botanical Journal" sheets that accompany this exercise. Enough should be made for each student to have a copy. All plant profiles may be used, or feel free to focus on only a few. "Botanical Journal" is easily tailored to meet curriculum or site needs. In addition, a blank plant identification sheet, called "Your Own Record," is included so that students may document a special plant of their own. (See Extensions for more information on this.) Compile "Journal" pages and secure with a paper clip, staple, or on a clipboard.

Methods for Identifying Plants

In the classroom before the field trip, the teacher should discuss how to identify a plant with students. Grade appropriate curriculum materials may be incorporated here. Of greatest use to students will be information on leaf size and shape; leaf arrangement on the stem; and flower, fruit, and seed structures. Numerous resources to plants and field guides are listed in the "Resources" chapter at the back of this manual. In addition, the "Background Information" section of this chapter offers useful identification tips in "Plant Terminology", "Flower Identification", and "Plant Adaptations". The activity "Floral Investigation" also makes an excellent warm-up activity for the "Botanical Journal".

Botanical Journal

ACTIVITY PAGE

Preview the Trail

Just a few days before the trip, the teacher should preview the trail where the field trip will take place. Flowers are ephemeral, fading away within a short time after blooming. What was in full glory over the weekend may well have disappeared by mid-week, and been replaced by something unnoticed before. The leader should locate some of the plants shown in the "Botanical Journal" beforehand, and make good notes about where they are so that the group will find them with ease.

Step-by-Step Instructions

1 On the field trip, find a quiet place to sit to go over the activity. Begin by passing out the "Botanical Journals", along with pencils, colored pencils, and a hard surface on which to write.

2 Go over each page of the "Journals" with the students. Explain that along the hike they will be looking for many of the trees, shrubs, and flowering plants shown inside. At various stops, they will have opportunities to observe and record in their books about the nearby plants. The purpose of the activity is not to record all plants, but to study a few closely. Plan plenty of time to do the writing on the hike.

3 Each page of the journal has a section in which students may make their own sketch, statement, poem etc. about the plant. Botanists study plants by making measurements and observations as well as by making "field notes." Many times these jottings end up having significant scientific value unknown at the time of record. The students will have a similar option.

4 Review National Park Service regulations about collecting with the class. Remind students to stay on the trails when looking for plants to protect the fragile cryptobiotic soil crust.

5 After hiking a good distance, stop at a place where there are enough plants along the trail for everyone to observe at least one. Give a set amount of time for students to make an entry in their journal. During the stop, the teacher and chaperones should roam among the students to assure that they are doing all right. Give reminders of the time at five minutes and one minute. See "Tips for Plant Watchers" for ideas of how to engage students in the task.

6 Make stops for other recordings. Occasionally, the teacher may want to have students report to the group some of their more interesting discoveries. Bumblebees, spiders camouflaged inside a flower, or signs of pack rats chewing on cactus pads will be of special interest to the class.

7 The teacher may want to alert the group to changes of habitat or places where two ecosystems come together. If it can be done safely, students should step off the trail to explore these border areas. Notice how many more plants grow there. Try to answer the question, "Why it is that where communities overlap, there are more plants?" Compare with other areas like slickrock. What factors influence both the type of plant and the number of plants in a certain area? Could it be soil, moisture level, elevation, wind, weather, or exposure?

Botanical Journal

8 If a plant is found that is not in the "Journal", use the "Your Own Record" sheets to make a record of it. Be sure to include specific details shown on the sheet, so that a correct identification may be made later using a field guide. Finalizing the plant species can be done back in the classroom, but complete field notes will make identification much easier.

9 If you have a camera along, photograph students making their observations. That way they will have a personal record of both their plant and the place it was found. Often children find far more meaning in photographs of their activities than adults expect. A Polaroid camera where the picture is immediately available, or one where the students can each take their own photographs, will be very successful with students.

Conclusion

Making a "Botanical Journal" of plants that students find at Colorado National Monument increases awareness of the diversity and bounty of these seemingly dry lands. Plants colonize the soil, and make it a more habitable place for wildlife as well as people. The ways that plants adapt to the limits of their environment, such as little water and lots of sun, are fascinating and impressive. Taking time to look closely helps students to appreciate the beauties, both large and small, around them. It also introduces and involves them in the scientific process.

Extensions

This activity has numerous adaptations and extensions. Foremost, it can be combined with other activities given in this manual. The "Territories," "Plant Scavenger Hunt," "Magic of a Drop of Water," "Crossword Puzzle," and "Floral Investigation" activities are easily linked with it, either in the field or later in the classroom.

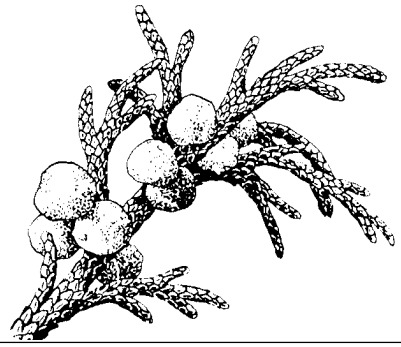
The teacher can also tailor the "Journal" to meet specific curriculum needs. If the class is studying trees, for example, the "Botanical Journal" can be used exclusively for trees. Alternatively, you can mix and match worksheets with other parts of the manual, such as the animal or geology chapters. The animal chapter has a "Wildlife Observation Sheet", scat and track identification sheets that can all be incorporated in with the plant worksheets for a more broad-based Colorado National Monument discovery packet.

Utah Juniper

ACTIVITIES FOR STUDENTS

The twisted trunks and deeply lined limbs of the Utah juniper are the centerpiece of many photographs of the western landscape. Stands of junipers, and pinyon pines, which often grow with it, cover thousands of acres of the arid southwestern United States and especially the state of Utah, for which this species is named. Juniper trees are part of the Cypress family, which includes about 70 species worldwide, and 13 species in the U.S. Because these trees have mistakenly been linked with the "cedar" family, they have spawned many place names, such as Cedar City, Cedar Breaks, and Cedar Mountain. These hardy and adaptable trees grow in alkaline soil, desert sands, cracks in rocks, even places where there seems to be no soil at all. In clearcuts and fire scars, they are often the first tree to set root and provide shade for the pinyons that will follow. Part of their durability comes from their slow growth and long tap roots. Follow the root of a Utah juniper, and you will be amazed how far beyond the tree it stretches. Its small, scale-like needles tightly clasp the twigs to minimize water loss. Instead of cones, it produces round, wax-coated berries that mature over two to three years. As they age, they change from green to reddish-brown inside. Rabbits, jackrabbits, coyotes, and birds eat them, while humans use them for medicinal, herbal, and flavoring purposes. Juniper limbs and trunks have been used for centuries. Puebloan structures in Chaco Canyon have juniper beams, and fence lines across the West are held up by juniper posts. Countless meals have been cooked over juniper fires. The shreddy bark has been collected to make sleeping pads, sandals, rope, even diapers. Utah juniper is marvelously adapted to desert life, making it a better place for all.

Up Close View

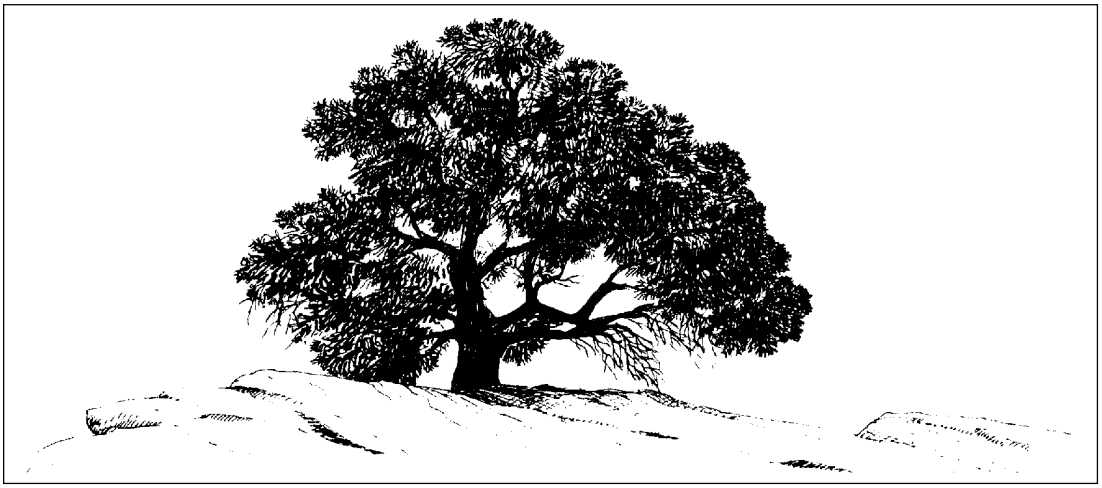


Your Field Notes/Sketch

Pinyon Pine

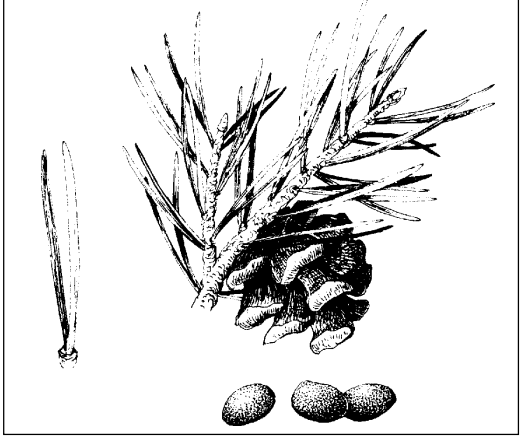
ACTIVITIES FOR STUDENTS

The pinyon pine, or piñon pine, is one of the best known trees in this region. Its name is Spanish meaning "nut-bearing pine." Large stands of these trees cover mesa tops, plateaus, and semi-desert lands between 4000' and 7500' in elevation, and occasionally higher. They are abundant from west and central Colorado, across Utah and Nevada, to the eastern slope of the Sierras. Their rounded, wide-spreading crowns also extend south into Baja, across central and northern Arizona, and green much of New Mexico. Because pinyons reach only 20 to 40 feet in height, they are often referred to as the "pygmy forest". Different species are recognized by the number of needles per bundle: singleleaf (1 needle), Parry's (4 needles) or hybrids (3 or 5 needles). Colorado pinyon, or *Pinus edulis*, with two needles per bundle, is found at Colorado National Monument. Every part of this tree has a value in nature. Their trunks supply firewood, charcoal, and support shade shelters and hogans. Porcupines eat the bark, while pack rats and mule deer consume the needles. Resin, or sap, is sought as food by insects, and waterproofs many baskets of the Ancestral Puebloan people. The seeds, or pinyon nuts, are enjoyed most of all. Rich in protein, fat, vitamins and minerals, a multitude of squirrels, chipmunks, rats, mice, bears, voles, insects – and of course, humans – feast on them. Pinyon, Stellar's, and scrub jays cache the nuts in the soil, thereby assuring that future generations of pinyon pines will grow.



Your Field Notes/Sketch

Up Close View



Tamarisk

ACTIVITIES FOR STUDENTS

Tamarisk is a ten to fifteen foot high shrub or small tree that grows along watercourses of the western United States, including that of the Colorado River. In spite of its abundance, tamarisk is not a native species. Introduced here in the 1800's, it has spread rapidly. Now, this non-native tree, which grows in dense, almost impenetrable thickets, threatens to out-compete willows, cottonwoods, and other water-loving native vegetation. Nevertheless, it is a striking looking tree, with feathery, soft-looking branches, and clusters of pink flowers in the spring. Its leaves are small, almost scale-like, to minimize water loss. The root system is deep and wide-spreading. These features make it well adapted to arid climates, and contribute to its successful invasion of drainages and riverbeds. The National Park Service is attempting to minimize the impact of its entry into the canyons of Colorado National Monument with programs to remove it.

Your Field Notes/Sketch

Up Close View

Rabbitbrush

ACTIVITIES FOR STUDENTS

Rabbitbrush, also known as Chamisa, is a two to four foot high shrub that is found in many parts of Colorado National Monument and the western United States. A companion of sagebrush, it grows on dry mesa tops, along roads and trails, and flourishes in moist drainages. Its stems are greenish-white in color, and quite straight as they emerge from a woody trunk. They have been used in basketry, for arrow shafts, and as fuel. The leaves are narrow, 1 1/2 to 3 inches long, with little value as forage for animals. In the fall, rabbitbrush is most striking, because its crown is covered with a profusion of bright gold flowers that emit a pungent smell. Its botanical name, *Chrysothammus nauseosus*, means "golden bush with a strong smell." After the blossoms fade, the seeds provide important winter food for juncos, sparrows, and many other seed-eating birds. Another name for this plant is "rubber rabbitbrush," for the latex-like sap that oozes from broken branches.

Your Field Notes/Sketch

Up Close View

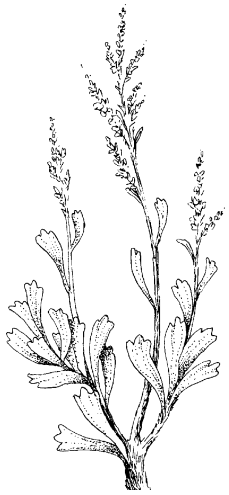
Sagebrush

ACTIVITIES FOR STUDENTS

Some people say the smell of the desert after a rain is one of the best imaginable. One reason is a three to six foot tall shrub called big (or tall) sagebrush. Its leaves contain an oil which has a fragrance that is unforgettable. However, it is not used in cooking. The spice, sage, is in the mint family, whereas the sagebrush of the dry lands, deserts, and mesas is in the sunflower (composite) family. The botanical name for sagebrush is *Artemesia tridentata*, from the Greek goddess of nature, Artemis. *"Tridentata"* refers to the leaves of the sagebrush, which are wedge-shaped with three (tri) teeth (denta) at the end. The green-gray leaves are covered with tiny hairs that both reflect light away, and catch any available moisture. In the late summer and fall, flowers that look like tiny clusters of yellow, and greenish-gray balloons bloom atop the bush. The roots of sagebrush run shallow (to catch any moisture from rain showers) and deep (to reach underground sources of water). In dry seasons, sagebrush can go into a dormant state until the next rains. Because of these adaptations, sagebrush is well-suited to desert life, and covers hundred of miles of the western landscape.

Your Field Notes/Sketch

Up Close View



Serviceberry

ACTIVITIES FOR STUDENTS

The rocky slopes below the red-orange cliffs of the Wingate Formation are dotted with a three to ten foot tall shrub that lights up the landscape when it blooms. In the spring and summer, serviceberry flowers form clusters of bright, white blossoms at the end of a stem. The five petals are one-half inch long and twisted, so that they look like tiny flags twirled by the wind. These flowers create the effect of snow-in-summer across the canyons of Colorado National Monument. Much of the rest of the year, serviceberry is inconspicuous. Its small, round, toothed leaves provide important shade, shelter, and forage for deer, bighorn sheep, rodents and birds. When its fruit ripen in mid-summer, they look like tiny, dry apples. Many birds and animals, like bears, consume them. As preserves, dried fruit, or mixed into jerky or pemmican, humans too enjoy serviceberries.

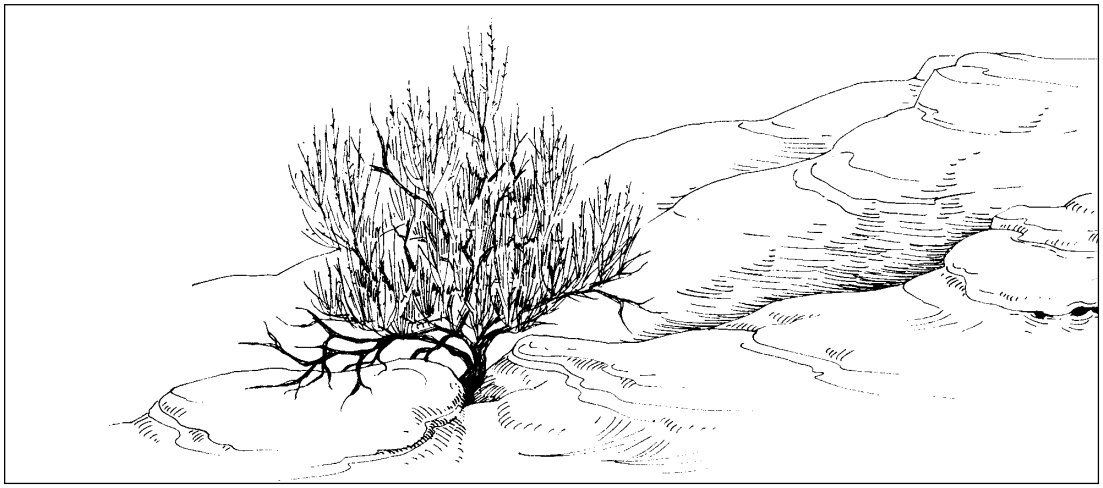
Your Field Notes/Sketch

Up Close View

Mormon Tea

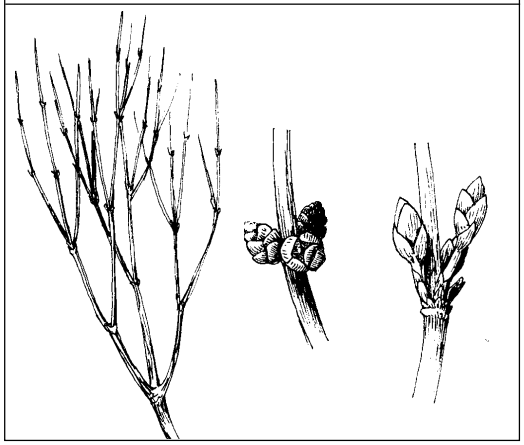
ACTIVITIES FOR STUDENTS

Mormon tea, or *Ephedra*, is among the most abundant plants at Colorado National Monument. It grows in canyons, on slopes, rocky areas, even cliffs. Because it looks like a cluster of dead twigs, Mormon tea is easy to recognize. Still, this distant relative of pine trees is very much alive, and superbly adapted to life in the desert. A member of the Joint-fir family, it grows in a skeleton-like arrangement of segmented green branches up to four feet tall. Rather than leaves, it has tiny scales that appear at joints, where the segments come together. This adaptation helps to reduce water loss. With such small leaves, Mormon tea instead photosynthesizes through chlorophyll in its branches. Separate male and female plants grow near to one another, and have cones instead of fruit. By looking closely, you can tell them apart. The male cones grow right next to the joints, whereas female cones have short stems that make them stick out more from the branch. Teas made from the branches of Mormon tea are said to cure many different symptoms and illnesses, and give the plant its common name. Relatives of this plant in Asia are one of the sources of the drug, ephedrine, which is used as a decongestant and for bronchial disorders. Our local plant, often called Ephedra, has minimal quantities of that drug, and simply makes a pleasant tea.



Your Field Notes/Sketch

Up Close View



Mountain Mahogany

ACTIVITIES FOR STUDENTS

Three species of mountain mahogany are found at Colorado National Monument: alderleaf, curlleaf, and hybrids of the two. All are very drought tolerant, slow growing, and have been found to fix nitrogen in the soil. You can see them on rocky slopes, mixed with pinyon and junipers, and on the sagebrush flats as well. *Cerocarpus*, meaning "tail-fruit", is the Latin name for this group of shrubs. It is most appropriate, given that the seeds are so striking. The small, green and yellow tube flowers have no petals, and develop into seeds with long tails covered with white hairs. Some years, the branches seem to fluff out with decorative plumes. As the seeds dry, the feathery "tails" curl up into corkscrews. When they fall to the ground, they are perfectly poised to dig themselves into the soil. The tiniest bit of rain or dew releases the coiled up tail, and powers the seed into the earth, thereby planting the next generation of mountain mahogany. In spring and summer, alderleaf is covered with small, oval leaves that resemble tiny rippled potato chips. They roll under on the sides as a way to reduce surface area and water loss. Leaves of curlleaf are narrow and pointed at both ends. Dark green on top and white hairy below, they also curl up, hence the name. Deer, elk, and bighorn sheep browse on the leaves and branches of these sturdy shrubs. Since the trunks are hard, strong, and quite straight, they have found many uses as arrow shafts, digging sticks, and in woodworking. Because they polish well, "mahogany" is an especially fitting name.

alderleaf in fruit

curlleaf in fruit

Your Field Notes/Sketch

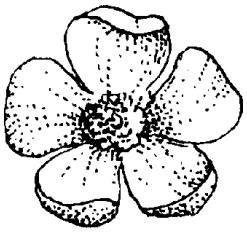
Globemallow

ACTIVITIES FOR STUDENTS

Unlike other members of the hollyhock family that grace many gardens, the copper globemallow is found in drylands, rocky or disturbed soils, and road sides. Locally, it grows along Rim Rock Drive, as well as trailside, on plateaus, and in canyons. This widespread perennial plant is very adaptable, in part because its extensive root system penetrates deeply into the soil. Like many desert flowers, it grows quickly during the spring, blooms in May to mid-July, sets seed, dries up, and disappears. Globemallow's pale green leaves are opposite on the stem, and are so deeply dissected (cut) that they look like tiny fingers. To the touch, both the stem and leaves feel powdery from a coating of tiny white hairs, which help to reflect away light and conserve water. The orange to scarlet colored flowers have five overlapping petals that create a cup-shaped blossom. In the center, bright yellow stamen are fused to the pistil. The botanic name for globemallow comes from the Greek words, Sphaeralcea munroana. "Alcea" means "mallow", and "sphae" means "sphere", which describes the fruit, which are little globes (spheres) that divide, like oranges, into five segments.

Your Field Notes/Sketch

Up Close View



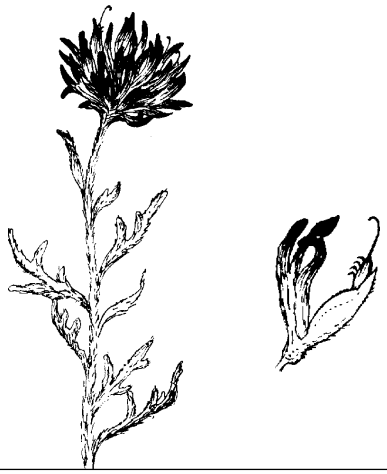
Indian Paintbrush

ACTIVITIES FOR STUDENTS

Indian paintbrush is easily recognized and appreciated for its brilliant scarlet, red, rose, yellow and orange colors. Named because it looks like a scraggly artist's brush dipped in paint, it may be found high in alpine meadows, growing out of cracks in slickrock, or tucked under sagebrush across the desert. If you look at it closely, what first appears to be red flowers are not flowers at all. Instead, they are small leaves, called bracts, that grow at the base of the flower. Usually bracts are green, but in the case of paintbrush, they are brilliantly colored. The flower itself is a small tube of dull color, often hard to distinguish within the bracts. Still, hummingbirds and bees know to find plentiful nectar at the base of this flower. Like many desert plants, the leaves of paintbrush are reduced in size, narrow and lancelike. Their gray-green color comes from tiny hairs covering them. The hairs assist in reflecting away light and conserving water. Perhaps the most unique quality of this plant is its tendency to be a parasite on sagebrush and other plants. By invading the roots of a host plant, paintbrush receives sugars, water, and minerals, in addition to shade from the desert sun. Look for these brilliant flowers from spring until late fall in all of Colorado National Monument's canyons, and along Rim Rock Drive.

Your Field Notes/Sketch

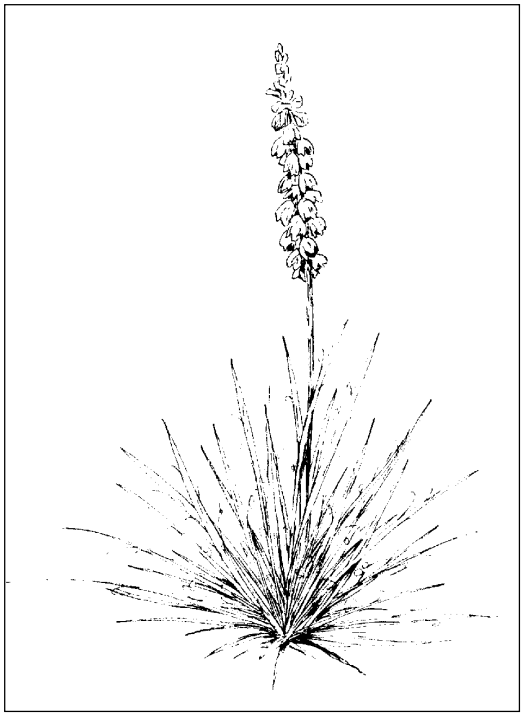
Up Close View



Yucca

ACTIVITIES FOR STUDENTS

Yucca is a common and easily identified plant at Colorado National Monument. Found in the dry soils of mesa tops and canyons, it grows from a central spot outward to form a tight cluster of spike-like leaves. Care should be used around these plants because the ends of the gray-green leaves are sharp and needle-like. Spanish bayonet and dagger plant are nicknames for yucca that derive from the pointed leaves. Another feature of yucca is that the leaves roll up along the sides, creating a channel that extends from the outermost point of the leaf downwards to the middle. Possibly this structure helps to catch and drain any moisture to the central stem. Strong fibers, prized by basket makers, line the leaves, and often curl up along the edges. In the spring, cream-colored yucca flowers bloom on a stalk that rises three to five feet in height. The flowers, which only open at dusk, have a remarkable relationship with a tiny night-flying moth. It places yucca pollen, along with one of its eggs, inside the stigma of the flower, thereby assuring both the pollination of the flower, and the safety of its young. Several weeks later, when a fig-shaped fruit ripens on the stalk, the developing larva eats some of the many seeds, and then chews its way out of the fruit to fly away. Can you find a tiny hole in a yucca fruit that a moth left behind? The roots of the yucca, like those of many desert plants, spread out far beyond the plant. For centuries, people have gathered them for their high quantity of saponin, a soap-like material that works well as a cleaning agent. Yucca is a fascinating desert plant, for its lovely form, its remarkable natural history, and its many uses.

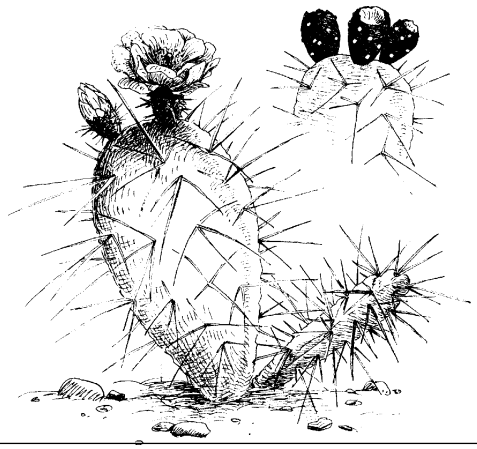


Your Field Notes/Sketch

Up Close View

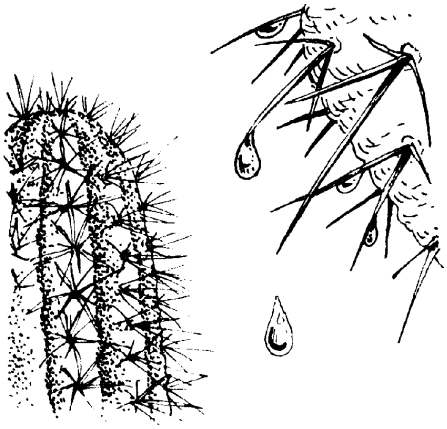
Cactus

The cactus is one of the best known desert plants. This spiny succulent has four important adaptations to survive in lands of little rain. First, it has an extensive root system that spreads far beyond the plant itself. Even the smallest amount of moisture is absorbed and put to use. Second, when it rains, the cactus has internal structures that act like reservoirs to store water for the future. Third, cactus has few, if any, leaves, thereby reducing sources of water loss. Instead, the stems, which are covered by a thick waxy coating, carry on the functions of photosynthesis and transpiration. Fourth, cactus has spines which protect it from animals that might eat it, and which help to shade it from the hot sun. Together, these features reduce moisture loss, and keep precious water in the plant. Cactus plants are well known for their beautiful flowers that bloom for as little as one day during the late spring and early summer. Their pollination is assured by insects and bees that are attracted to the brightly colored petals and the ample amounts of pollen. The fruit that follows is enjoyed by many creatures, most notably the pack rat. Of the 2000 species of cactus found in our hemisphere, eight are found along Colorado National Monument's canyons, mesa tops, slickrock, and trails. Prickly pear cactus, which looks like a rambling collection of flat, oval-shaped pads, one atop the other, grows low to the ground, and can cover large areas in the canyon bottoms. Its flowers are yellow to pink, and its fruit reddish. Claret-cup cactus is small, with a ridged stem and brilliant red flowers. Because of their unique beauty, and desirability for dry-land landscaping, many species of cactus are becoming threatened or endangered.



Your Field Notes/Sketch

Up Close View



Find Your Own Plant

ACTIVITIES FOR STUDENTS

Name of plant, if known: _____

Describe your plant. Begin at ground level, and estimate its height. What are the size and shape of the leaves? Are the leaves arranged opposite each other, or alternating on the branch or stem? Are leaves/stem hairy, smooth, or powdery? Are leaves curled under or up? Are they narrow, wide, cut up, wavy, or smooth? Do they seem waxy, shiny, or succulent? If flowers are visible, count the number of petals, stamen, and comment on their colors and arrangement. If fruit are visible, what are their shapes, sizes, and colors? Are there spines or other interesting features? Do you see any signs of insect, spider, bird or mammal use of the plant? Where is your plant located? Is it near water, on slickrock, in a canyon, along the road, trail, etc. After you have recorded your discoveries in the space below, compare your plant with the plants described in the "Botanical Journal". Does it match any of them? If so, write its name in the space above. If not, try using a field guide to plants, or ask your teacher to help you identify what kind of plant you have found.

Sketch your plant. Include its stem, leaves, flowers, fruit or other interesting features. This is to help you remember it, and does not have to be a great artistic creation.

The Magic of a Drop of Water

ACTIVITY **PAGE**

Age Level

4th through 8th grades —
as well as ages younger and older.

Purpose of the Activity

This activity is an investigation of the effects of water on cryptobiotic soil crust (formerly known as cryptogamic soil). After a cup of water is poured on the cryptobiotic soil crust, students watch a remarkable transformation of the organisms from a hard, wizened, dry crust to a soft garden of diverse plant life. The adaptability and resilience of plants in a desert environment is dramatically underscored in this short project.

Best Location

Perhaps the most easily accessible area for this activity is along Old Gordon Trail after the split of Old Gordon and No Thoroughfare/Devils Kitchen Trails. However, many other trails, including Monument Canyon, Otto's, Liberty Cap, and Coke Ovens also have extensive areas of cryptobiotic soil crust. This activity can be done at any point that suits the needs of the group, but works very well as an introduction to desert from the trail. It must be located in such a way that everyone in the group can reach it without walking off the trail. This soil crust is very fragile, and damage to it can last for many years. Therefore, students must have easy access so that little impact from their presence will occur.

Materials Needed

In addition to a large area of cryptobiotic soil crust, the materials that you will need are:

- ☐ Hand lens. Preferably one for each student or pair of students.
- ☐ Water. Enough for one cup per student.
- ☐ 5 ounce or larger paper cups. One per student.
- ☐ Stop watches or watches with second hands on them. (Extension for grades 6 through 8.)

The Magic of a Drop of Water

ACTIVITY PAGE

Background Information

Cryptobiotic soil crust has received increasing attention over the past few years as more visitors come to explore the national parks and monuments of the Four Corners Region. In truth, this type of soil crust has existed for multitudes of years without much recognition. Now, because more people hike trails, ride bikes, camp, raft, adventure, and use off-road vehicles in the desert, damage to this fragile environment has been occurring at a faster and faster rate.

What is Cryptobiotic Soil Crust?

Previously known as cryptogamic soil, cryptobiotic soil crust derives its name from the Greek words, kryptos, meaning "hidden" or "covered", and -biotic meaning "having a mode of life." A hidden life it is indeed!

This soil crust is composed of many of the simplest plants in the plant kingdom. Tiny filaments of blue-green algae (known as cyanobacteria), as well as other algae, intermingle with mosses, lichens, and fungi to create a miniature community that is scarcely two inches high. Many of the elements of cryptobiotic soil crust, the Thallophytes, or algae and fungi, have no roots, stems, leaves, or flowers. The Bryophytes, which include mosses, have stems and leaves, but no roots or flowers. Without the glamour of size and colorful flowers, the members of this plant community are easily overlooked, and unappreciated.

The Contributions of This Soil Crust

The contributions of these simple plants to the desert environment are nonetheless important. First, they grow slowly, both above and below the soil, to form a complex of organisms that help hold soil in place. They act like a net, trapping soil particles so that they will not blow or wash away. Second, they add valuable nutrients, such as nitrogen, to the soil. Third, as they decompose, they add critical organic matter to the soil. As a result of these contributions, the desert soils are richer, better able to hold water, and more hospitable for other plants. In all of these "hidden" ways, cryptobiotic soils perform a life-giving role in the desert.

Impact of Their Destruction

The destruction of these soils by people unfamiliar with the desert, and unaware of the impact of their vehicles, bicycles, even footsteps, has serious consequences. Without the protective cover and nutrient benefit of cryptobiotic soil crusts, plants do not have a foundation, and soils rapidly erode. Damage this significant is not easily repaired. Scientists estimate that from 50 to 250 years are needed for these soils to recover. In some areas, no recovery will occur. What took years to develop can be undone in a few seconds of careless walking or biking. As much as we profess to care about the lands around us, we need to take care of all parts of them, even the tiniest of communities of cryptobiotic soil crust.

The Magic of a Drop of Water

ACTIVITY PAGE

How to Recognize These Crusts – Color – Texture

How do you recognize cryptobiotic soil crusts? Color is one indicator. If you see area where the earth is black, gray, brown, reddish, even beige, look more closely and you may find it to be cryptobiotic soil crust. Variations may occur depending on local soils, amount of water, composition of organisms in the soil, and age of the crust. Older crusts tend to be darker, while ones newly forming may be nearly invisible.

Texture is a second way to recognize cryptobiotic soil crust. Have you ever poured water on sand and let it dry? When you touch it afterwards, it may look solid, but crumbles in your hand. So it is with this soil too. Filaments of the algae penetrate down into the soil, and help to stabilize the grains of earth into a solid layer. Because many other tiny organisms such as fungi, lichen, moss, and other types of algae also grow in this crust-like layer of soil, it is not smooth. You may notice bumps, lumps, heaves, even knobby areas within it. Using a hand lens, you may distinguish the different kinds of tiny plants forming a patchwork of plant life across the earth.

Adaptability of Soil Crust

A remarkable feature of cryptobiotic soil crust is that it survives in places where temperatures are high, there is lots of sun, and very little water through part of the year. This adaptability occurs in part because the lichen, fungi, moss, and algal components exist in a dormant state in dry periods. They further protect themselves from water loss with leathery surfaces; reduced to minimal leaf size; and wide-spreading rootlets, rhizomes, and algal threads to absorb any moisture that becomes available. Much the way a kitchen sponge dries up, contracts, and hardens between uses, so it is with cryptobiotic soil crust.

When it rains, however, a magical transformation occurs. The lichens soften and become more brightly colored. The mosses, which have looked like black lumps in the soil, turn green, and their tiny leaf-like appendages expand outwards. Also shriveled and dry, the fungi soak up water and swell up. Distinct plants and plant parts become visible across the soil crust. There is a magical quality to this transformation, almost as if the wand of a fairy godmother were waved…

All this is visible for students through the “Magic of a Drop of Water” activity.

The Magic of a Drop of Water

ACTIVITY PAGE

How to Do the Activity

Before the Field Trip

Before the field trip, gather materials and plan to carry plenty of extra water with you. The experience of the swelling, expanding, and unfolding of the soil crust is very compelling and intriguing for students. Often they want to repeat the activity over and over. As water is a precious commodity in the desert for people, bring extra water along so the students will not deplete their own supplies in the experiment.

As always, preview the trail to chose the perfect area for this activity. Remember each student will want to do this for themselves, so that plenty of cryptobiotic soil crust is needed.

Step-By-Step Instructions

Review the material above on cryptobiotic soil crust, as well as other information on plant adaptations in the Background Information section.

1 Before you get to the destination for this exercise, stop and explain what you will be doing. Encourage students to take a drink of their water as you discuss how plants and animals adapt to survive in a place with so little moisture.

Pass out hand lenses and explain how to use them. Be sure to mention that if anyone is seen using them in dangerous ways (such as magnifying the sun on the ground, or on a person) they will be taken away.

2 Using information from the section above, discuss what cryptobiotic soil crust is, and how it is extremely fragile. While the experiment of pouring water on it will not damage it, a misplaced backpack, or inattentive step, could indeed impact it. Great care should be taken by students as they work so that none is destroyed.

3 At the site, spread students out so that each person has a bit of crust before them. Ask them to investigate it in its dry form using a hand lens. What do they notice? Can they recognize individual plants? Touch the crust. How does it feel? After some discussion, pass out a cup to everyone. Designate a teacher's aide or chaperone to go along the line filling cups with the same amount of water for everyone.

4 Have everyone pour their water at the same time on their dry section of cryptobiotic soil crust. This must be done slowly, in small amounts, or much of water will run off and be lost.

Now the observing begins. What happens to the water? What happens to the soil crust? Inspect it with the hand lens. What is different now? Ask students what they notice about colors, sizes, and shapes of the plants in the soil. Can they recognize any? How is the crust different after the water is absorbed?

The Magic of a Drop of Water

ACTIVITY PAGE

5 All students should have noticed on their site, or on that of their neighbors, a dramatic change in the way the soil crust looks. After talking about the changes in the soil crust that they observe, use the Plant Adaptations information sheet to assist the class in observations of how the algae, mosses, fungi, and lichens could survive without water. Make a list of the different strategies that they could use to survive without water. (Dry out; go dormant; have thick, waxy coating; grow widespreading and shallow roots; have a fast life cycle are some of the many answers to look for from students.)

If these are ways that this tiny community of plant organisms survive, how could larger plants, like those around you, survive?

What methods could larger plants use to protect themselves in the desert?

6 In conclusion, ask for words, images, or phrases that students think of having seen the effect of water on the cryptobiotic soil crust. What ways can they think of to help preserve this delicate environment?

With older students, grades 6 to 8, the following extensions can be added to make the activity more challenging and to incorporate it with the curriculum needs.

Conclusion

Cryptobiotic soil crust is a fascinating assemblage of plants, algae, fungi, and lichens that are marvelously adapted to survive under harsh conditions with little water. It makes one drop of water seem like an amazing life-giving substance. It daily pioneers the creation of soils, growing, aerating, penetrating, and improving dry desert sands for the benefit of other plants. To continue its vital role, this fragile habitat needs our protection. Not only must hikers, joggers, cyclists, horseback riders, and campers be careful where they step, but they must remember that they are only visitors to these soils. Their passage through this environment should benefit it, not destroy it.

The Magic of a Drop of Water

ACTIVITY PAGE

Extensions

Grades 4 and 5

1 Write a story or poem that describes what you saw take place when you poured the water on the cryptobiotic soil crust. Describe what the soils looked and felt like beforehand. Discuss what happened when you poured on the water. What happened to the soil crust after the water was absorbed? Draw pictures to illustrate your story.

2 Imagine that Colorado National Monument has hired you to prepare an education campaign about cryptobiotic soil crust. Create a sign that will help to educate visitors about fragile area soils. What should and shouldn't they do when hiking, biking, camping, or cycling? Can you invent a slogan that will help protect these soils? Use crayons, paints, or markers to color your sign.

Grades 6 through 8

1 Find out which students have watches with a second hand, or stop watches built in to their watches. Ask one person to be the timekeeper in this next segment of the experiment. Their job is to notify everyone of one, two, five and ten minute intervals.

Have students pick a new site of cryptobiotic soil crust to use. It should be several inches to a foot away from the one where the water was originally poured. At this new site, students should measure out an area of 3 inches by 3 inches. This is approximately the length of one of their fingers. The corners of the plot should be gently marked with pebbles.

Once the plot is established, ask students to make note of the plant size in the dry soil crust. Have them use hand, fingers, and fingernails for comparison. Ask them to make a count of all the plant organisms they can see in the crust. Remember these numbers, or write them down on a piece of paper.

Then, at a signal from the timekeeper, have students pour a new cup of water on the plants that were measured. After one minute passes, get students to remeasure their plants. After two, and again after five minutes, remeasure. Discuss the results. After ten minutes, do a final measurement. What happened? Compare results at this second plot with those at the first area where water was poured.

The Magic of a Drop of Water

ACTIVITY PAGE

Math Content Standards

2 Another extension of this activity is to incorporate math content standards involving measuring, projecting, percentages, and word problems.

Math calculations: Measure off an area of cryptobiotic soil crust that is three inches by three inches in size. Mark off the corners of the area with pebbles. Get down close and count how many different tiny plants, lichens, and fungi you can find within the area. Write these figures down on a piece of paper. Can you determine where the algae is? If so, what percentage of the area is covered by it? 10%, 25%, 50%, 75%, 90%, or 100%? Can you do the same with lichens, moss, and fungi?

Projections

Your 3 x 3 inch plot (9 square inches) has ___ number of lichens in it. Assuming the number of lichens remains constant, how many lichens would be in 12 x 12 inch plot? 36 x 36 inch plot?

Compare the number of lichens with the total number of plants counted in the plot. Calculate what percent of plants are lichens.

Repeat with the other plants. What percent are fungi? moss? algae? other? Many other calculations and projections from the information gathered can be made to coordinate with the math curriculum that is being covered by the class.

Plant Scavenger Hunt

ACTIVITIES FOR STUDENTS

Age Level

4th through 8th grades. Study of plants, plant parts, plant identification, and adaptations prior to field trip will make this easier.

Purpose of the Activity

This scavenger hunt is intended to get students to look closely at plants, trees, and shrubs in order to find the answers on their worksheet. See Extensions for numerous ways to adapt this activity.

Amount of Time Needed

30 - 45 minutes if students have a familiarity with plants, and longer if not. Older students will complete it sooner than younger students.

Best Location

Devils Kitchen Trail, No Thoroughfare Canyon Trail, Old Gordon Trail, Monument Canyon Trail, or Lower Monument Canyon Trail. You could also use Canyon Rim Trail or Alcove Nature Trails, but they may not be long enough in the fall to find all items. See Extensions for ways to adapt the scavenger hunt for different seasons, ages, time frames, and trails.

Materials

One copy of the scavenger hunt per student, and pencils, are all that is needed to do this activity. A clipboard or something to write on is helpful. Prizes or rewards work as good incentives, and are an optional addition to the activity.

Background Information

Scavenger hunts play a useful role in both the short field trip and the day long or overnight experience. Not only do they give a focus and structure to the students, but they teach valuable observation skills and information as well. Their flexibility is another asset. They may be done as teams or individually. They can be done as a whole, or in part. Substitutions for seasons and conditions are easily made. Finally, scavenger hunts may be handled cooperatively or as a competitive game.

This plant scavenger hunt is not easy. Time must be taken with it in order to discover the plants and the features that are listed. Students must slow down and LOOK! Fourth and fifth graders may be more comfortable working on the hunt as teams. Older students may prefer to work alone. Feel free to choose the structure that is best for the students, or the teacher.

Plant Scavenger Hunt

ACTIVITIES FOR STUDENTS

Plan a minimum of 30 minutes for this activity. The more time for exploration, the more discoveries will be made.

The teacher should review the Background Information section of this chapter to feel more at ease with questions that might come up. Material in Plant Terminology, Plant Adaptations, and Plant List of Colorado National Monument will be especially helpful. Because numerous plants are discussed in the Botanical Journal activity, a review of it is worthwhile. Finally, Tips for Plant Watchers is also recommended to assist with students who may not be interested in the topic.

Before the Field Trip

Before the field trip, copy the worksheets, and any other information that you want to take with you in the field. Gather pencils and clipboards for students. As always, it is recommended that several days before the trip, the teacher preview the trail, so that good areas for the activity can be predetermined and planned.

Decide if you want to have the scavenger hunt be played competitively or cooperatively. The benefit of it being a race is that the students who are not as interested in plants might get caught up in the game aspect of the hunt. The drawback is that students may not be as careful, or observant, if they are trying to get done first.

Lastly, decide if you want to give prizes or not. Fun (and easy) prizes related to plants are a carrot, an apple, a bag of peanuts, handful of sunflower seeds, a squirt from a water bottle (rain).

Step-by-Step Instructions

1 Decide beforehand if the class will do this activity as individuals or as teams. If teams are chosen, then have students pick their team members before passing out the scavenger hunt sheets. Each person should have their own sheet whether working as a team or individually.

2 Give directions (from the worksheet). Go over the scavenger hunt worksheets with students to answer any questions that students have.

3 Establish some clear rules and boundaries before starting out. Recommendations include:

- NO COLLECTING OF PLANTS OR PLANT PARTS.
- No pushing or shoving.
- No exclusivity of observations. More than one person or group can make the same observation.
- Stay on the trail due to cryptobiotic soil.
- No running on trail.
- Stay with the group.

At this age, the students can make up their own rules and regulations for the activity. Often they are more strict than those the teacher might impose.

4 Have chaperones and aides spread out among the group to be available to assist with questions or observations.

Plant Scavenger Hunt

5 Set a time limit, and let them know when they are half way through it, when ten, five, and two minutes are left.

6 Gather everyone together to hand in their sheets. While one person compiles information about who found the most answers, have students share some of their most interesting observations.

Ask them what they learned by doing the hunt as a way of getting feedback.

Conclusion

Scavenger hunts help students to focus and observe numerous details about a subject such as plants.

Extensions

Seasonal Studies

1 This scavenger hunt can be adapted to seasonal variations and curriculum needs. For example, if the class is studying flowers, and it is spring, substitute flower types, stamen counts, pollen colors, and petal counts to customize the hunt. Alternatively, if trees are a focus, include observations of bark, leaf arrangement (alternate or opposite), leaf shape, needle length, venation, and other comparisons. In the fall, seeds, fruit, berries, and nuts are plentiful for adding to the hunt.

Plant Adaptations

2 Plant adaptations for survival can also be an effective focus for the scavenger hunt. Finding waxy coating, evergreen leaves, curled leaf margins, spines and scales instead of leaves, small leaf size, hair on leaf undersides, hair on stems and leafs, powder on leaves, parasitic plants, etc. can be added to the worksheet.

This is a good fall activity, after flowers and many fruit have gone.

Bingo

3 If time or attention span are factors, have students just complete one row of the hunt, like the board game "Bingo."

Interpretive Writing

4 Older groups can use the last square, the "find your own," to make up a riddle, poem, or story about one of the discoveries that they made. This type of interpretive writing can be inspired by the teacher's reading of poetry by writers such as A. R. Ammons, Carl Sandburg, Wendell Berry, e. e. cummings, Robert Bly; or the haiku of Basho or Wang Wei. *Once There Was a Tree*, by Natalia Romanova (Dial Books, 1985.) is a children's book about the cycle of life of a tree. Many similar and marvelous accountings of life are available in the library or bookstores. Several other options include: Ruth Heller's *The Reasons for a Flower*. Grosset & Dunlap. Anne Dowden's *The Clover and the Bee, A Book About Pollination*. Thomas Crowell.

Plant Scavenger Hunt

ACTIVITIES FOR STUDENTS

Directions: Working alone or with a partner, look along the trail for the plant features listed below. When you locate one of the answers, fill in the blanks (if needed), and then cross the item off by making a line across the box. Do not expect to get this done quickly. You will have to look carefully along your path to find everything. GOOD LUCK!!
Remember you must stay on the trail, and you may not pick or collect anything!!

Find

A flower in bloom or bud.	What color is the outside shell of the pinyon nut?	A dead flower.
A blade of grass.	The veins of a leaf.	What kind of leaves does a juniper tree have?
A berry. (Hint: Look for a juniper tree.)	The flower, fruit, or pad of a cactus.	What sign of an animal or bird can you find? (Clues: Scratch marks, chewings, holes, diggings, droppings.)
What color are the stems of the Mormon tea plant?	A hairy leaf or stem.	Find a fruit or seed. What value does it have to the plant?
How many needles does a pinyon pine have?	What value is there in a dead tree or plant?	A plant that smells.
A plant growing on, or from, the roots or branches of an-other plant. (Clue: Look for mistletoe or Indian paintbrush.)	Roots of a tree or plant.	Name a way that a plant or tree can conserve water in this land of little rain.
Sagebrush.	An insect or spider on (or in) a plant.	Fill in the blank with your own discovery!
Cryptobiotic soil crust.	New growth on a plant, shrub or tree. OR A new plant sprouting out of the ground.	Fill in the blank with your own discovery!

Floral Investigations

ACTIVITY PAGE

Age Level

4th through 6th grades.

Purpose of the Activity

In this activity, students take apart a flower in order to identify its features. In the process, they learn about the functions of all the different flower parts, and how they work together to assure the future of the plant.

Amount of Time Needed

15 - 30 minutes.

Best Location

Classroom or school yard.

Materials

- ☐ Flowers from a florist or local gardener. (One per student, plus 5 to 7 extras for demonstration.)
- ☐ Magnifier. (One per student.)
- ☐ Blank paper. (One sheet per student.)
- ☐ Colored pencils or markers. (One set per student.)
- ☐ Floral Map worksheet. (One per student.)
- ☐ Bag of peanuts in the shell. (Enough for everyone to have a handful.)
- ☐ Copies of "Plant Terminology" and "Flower Identification" sheets from Background Information section. (For leader.)

Background Information

The Reasons for a Flower

Flowers appeal to us, to our emotions, aesthetics, and, of course, our senses. They are associated with music, art, poetry, romance, beauty, and sentiment. We grow them in our gardens. We buy them for our mothers, friends, and even ourselves. We send them in remembrance and in celebration. Our children carry their names, Rose, Daisy, Violet, Lily, even Ginger. The names we give to flowers reflect our tenderness for them: forget-me-not, baby's breath, sweet pea, morning glory, butter cup, bleeding heart, jewel weed.

Such emotions extend far back in our history. In Iraq, a cave was discovered where Neanderthal people were buried. Pollen grains were found all over the cave, and it appears the people were covered with flowers at the time of their burial. Similar traditions may be found in many cultures, including our own modern style of commemorative wreaths, laying flowers on the casket, and bringing flowers to the grave site.

Descriptions of the Parts of a Flower

For all the meanings with which humans imbue flowers, their real function is much more pragmatic: reproduction and survival of the species. The parts of the flower, from the bud, to the blooming, to the fruit, to the seed, are designed to assure that the next generation of plants gets started. All that beauty, all that fragrance, all that color and shape are part of a strategy to bring about seeds. From the inside out, the organization of a flower is to that end. It is a fascinating and complex story, with one chapter being about the flower, and the next about the seed.

As the reproductive organs of plants, flowers contain both male and female cells. Still, most plants do not fertilize themselves. Instead, they get male cells from another plant of the same species to cross-fertilize their female cells. In order to accomplish this feat, plants utilize remarkable and ingenious methods to get the next generation started. While some plants get help from the wind, others entice bats, birds, bees, flies, ants, beetles, and spiders to be their "transfer agents." While pollination cannot be assured in all cases, plants are amazingly successful in accomplishing this drama of bringing male and female cells together.

Botanists refer to flowers as plant shoots designed for reproduction. The base for a flower is an enlargement of the stem known as the receptacle. Arranged in circles on the receptacle are two important parts of the flower, the calyx and the corolla. The calyx is made up of sepals, green, leaf-like appendages which protect the flower as a bud, while its tissues develop. The calyx also shelters the ovary, where the seeds will grow. Inside the calyx is the corolla, better known as the petals. Usually the number of sepals and petals is the same within a flower. Together these parts form the perianth, the outer tissues of the flower called the "floral envelope."

Why Petals?

Flower petals grow in many shapes and arrangements. They may be separate, united, fused, symmetrical, regular or irregular. For students, these terms are not nearly so important to know as the real purpose of petals which is to attract insects, birds, and bats to pollinate the flower. In essence, petals act as advertisements to call in helpers from the outside world. Once a bee or moth is attracted, the petals operate as a place for the insect to land. Many have tiny lines from the tip of the petal to the inside. Known as nectar guides, these lines direct the insect down into the central part of the flower, where both the "food" is, and where the transfer of pollen can take place. Additionally, the petals act to shelter the inner parts of the flower from the elements.

Floral Investigations

ACTIVITY PAGE

Male Flower Parts

Tucked inside the corolla are the male and female parts of the flower. Usually, the male parts surround the female part, and are known as the stamens. Every species of flower has a specific number of stamens, which is a key to its identification. Each stamen is composed of a filament and an anther. The filament is a sturdy stalk whose function is to assure the anther gets as much exposure as possible. The anther is a small pouch(es) that contains pollen. Pollen hold the male sperm nuclei. They are like the fingerprint of the flower, with each species having its own uniquely shaped granule. Amazingly sturdy, pollen grains can exist for hundreds of years, as is witnessed by their discovery in amber, in the ashes of Pompeii, and in the caves in Iraq referred to earlier.

Female Flower Parts

At the very center of the corolla is the pistil, or female part of the flower. Ringed by the numerous, feathery stamens, it, too, has a distinct shape. It looks like a balloon that has not been blown up, or a goldfish with a very long tail that is standing on its head. The pistil may be single or made up of several parts. Another term for the pistil is carpel. A flower may have a single or compound carpel.

Each pistil is made up of three elements, the stigma, the style, and the ovary. The stigma is the landing area for the pollen. As a result, it is often enlarged like a little ball, a sponge, a star, or a feathery square. Each plant species has a uniquely shaped stigma. Often the stigma carries a sticky substance on it to help hold onto the pollen that reaches it. Under a hand lens, one may be able to see tiny structures that resemble velcro that also assist in holding onto pollen.

Attached to the stigma is a tube-like structure, the style, which connects to the ovary. The style functions like the tube on a balloon. Just as air passes down the tube and into the sac at the end of a balloon, so the style helps to convey the male pollen down to the female ovary at its base. When a pollen grain lands on the stigma, it germinates, and grows a tube. The tube extends down the style until it reaches the ovary. The ovary is a swelling at the base of the style which contains the ovules, or female cells.

The Fruit and Seed

Once the male sperm cells have been “delivered” to the ovary, they fertilize the ovules. The next generation of plants is held within the resulting embryo. The ovules develop a cover, or seed coat, to surround and protect the embryo. The calyx and ovary grow into a fruit, a variously shaped and colored package that further shelters the embryo plant, now a seed, inside.

To imagine what this really looks like, think of a peanut. When you open a peanut and look inside, frequently you see a tiny embryo plant tucked inside. The meat of the peanut protects and nourishes the tiny plant while it awaits the proper conditions for growth.

Covering the peanut is its skin, and around that is the shell, both of which afford further safekeeping for the tiny plant hidden deep inside.

Floral Investigations

ACTIVITY PAGE

The first chapter in the story of plants is complete: pollination and fertilization are accomplished. Therefore, the petals wither and die. The next chapter of the story unfolds as the fruit develops and ripens with the purpose of getting the seeds dispersed. Since it is most favorable to move away from the parent plant, the fruit helps in that process: poppies and locoweeds explode; milkweeds cradle the seeds until they split open and are carried away by the wind; cherries get eaten, and the seeds released with a pile of droppings to act as fertilizer. The mechanisms for dispersal are as diverse and unusual as the mechanisms for attracting pollinators.

In chapter three, the seed functions to give the embryo plant inside as good a start as possible. It contains a reserve of food inside, to nourish and shelter the young plant during the time before sprouting and photosynthesis. A tough outer coat, the testa, protects the plant inside from drying out. Inside this sturdy shelter, the young plant can survive for long periods of time, awaiting the proper conditions to germinate and begin the cycle of life once more.

How to Do the Activity

Getting Ready

Before the activity, contact local flower stores or gardeners to find out what types of flowers they have available. Find out if they would be willing to donate flowers for the activity. As flowers have a short shelf life, and regular shipments come in, flower stores are often happy to help you out. In turn, this activity can be scheduled to coincide with delivery days.

You will need flowers that are in bloom, not buds. Preferred flowers are: tulips, lilies, gladiola, or alstromeria. The latter three flowers work especially well because they have numerous blossoms on a single stalk. You do not want to get daisies, asters, roses, or carnations, or other flowers with stamen and pistils that are difficult to see. Plan for one flower per student. Try to have all students working with the same species if possible. A few extra flowers of other species can be useful to demonstrate the wide range of shapes, sizes, colors and structures of flowers. These can also be used as challenges to see if the students can find all the parts.

Copy the “Floral Map” worksheet for each person. It will be a helpful guide to locations as well as terms. A magnifying glass or hand lens for each student is also useful.

Practice on a flower yourself. As the instructor, it is helpful to recognize all the features readily.

Floral Investigations

ACTIVITY PAGE

Step-by-Step Instructions

1 As you pass out the worksheet, hand lenses and flowers, explain that students will be investigating a flower to learn its parts, and how they work together. Each person will take apart a flower. To assure that everyone sees all the elements, follow directions carefully. DO NOT TAKE OFF PARTS OF THE FLOWER UNTIL YOU ARE TOLD TO DO SO.

2 Begin the floral investigation by inspecting the stem or stalk of the flower. Notice where it widens out into the flower itself, called the receptacle. Can you find the sepals, small green leaves that are at the base of the flower? How many are there? Write down this number on the worksheet. Pull off a sepal and look at it. How does it compare to a leaf on the plant? The ring of sepals around the base of the blossom is called the calyx. See Background Information for details on function. Pull off all sepals and set aside.

3 Next, look at the petals. Note their color, shape, and size. Count how many there are and compare with the number of sepals. Write the number of petals down. Pull off a petal and look at where it connects into the receptacle. This ring of petals is called a corolla. See Background Information for details on function.

4 Can you find any lines that run the length of the petal? They will go from the tip of the petal towards the central part. These are called nectar guides. The function of the petal is as a landing pad for insects and birds, and the nectar guides help direct them into the center of the plant. They are like the lines on a road that keep the cars going to where they are supposed to be. Use magnifiers to look closely at a petal. Pull off all the petals and set them aside.

5 What remains after the petals are taken off are the central elements of the flower: the male and female parts. The reason for a flower is to assure that pollen from the male stamen gets over to the female pistil, thereby fertilizing the eggs held down within the ovary. Look at the next ring of the flower. It is made up of the male parts called the stamens. Count how many stamens there are in this ring. Different species of flowers have different numbers of these. Record the number on your worksheet. Afterwards, take off ONE stamen and look at it carefully.

6 Can you find a pouch (anther) sitting atop what looks like a tiny drinking straw (filament)? The pouch is the sac that contains the pollen, or male cell of the flower. Gently shake the pouch over the palm of your hand. What happens? Some students will get a handful of tiny specks, called pollen granules. Other students will not, either because their flower is not yet ready to release the pollen, or because it is sterile. Have these students try removing a second stamen, and shake its anther. If need be, let students borrow a little pollen from a neighbor. Everyone should look at the pollen with their hand lens.

The purpose of the filament is to hold up and display the anther. This gives the pollen grains inside an optimal chance for dispersal. Because pollen is highly nutritious to insects, they are attracted to flowers to eat it. In the course of eating their fill, they knock into the stamens, which drop pollen onto them. As the pollen-covered insects move on to other flowers, they inadvertently transfer the pollen from flower #1 to flower #2. Anthers have an amazingly high amount of pollen to assure that some portion of it will survive long enough to be introduced into the female part of a neighboring flower. Remove yet another anther, shake it in your hand, then guess how many pollen granules are released. Multiply this by the number of stamens in the flower. An impressive number will result!

Some trees and flowers produce higher amounts of pollen than others. Most of these plants do not depend on insects, birds and bats to transfer pollen: they take their chances with the wind. These flowers have long pistils with plenty of sticky material on them to catch any male pollen flying by on the breeze. Many humans do not appreciate this reproductive effort by plants, such as junipers and blue spruce, because the huge amounts of pollen released into the air cause them allergies.

7 At this point, remove any remaining stamens and set them aside. Can students tell how many stamens there were in their flower? Botanists standardly use petal number, stamen number, and pistil number in plant identification. The number of stamen is the same within a plant species, and therefore useful in distinguishing plant species.

8 By this point, all that should remain of the original flower is a tall, funny looking tube in the middle of the receptacle. (Some students will have accidentally pulled off this part too. Have them look back through their stamens for it, or they can look on with a neighbor.)

The remaining element in the receptacle is the female part of the flower, known as the pistil. It has several parts. First, use a hand lens to look at the top of the pistil. Can any pollen be seen sticking to the top? This feathery or enlarged area at the top of the pistil is known as the stigma. Its role is to catch pollen, and hold onto them until they can fertilize the ovules inside. Often the stigma has a sticky substance on the top, or little hooks (like velcro) to hold onto the pollen.

Floral Investigations

ACTIVITY PAGE

9 After the pollen lands on the stigma, or is brought there by a roving insect, the pollen granule develops a long tube, which grows down the neck of the pistil, to a sac at its base. VERY CAREFULLY have students remove the stigma and pistil (tube).

In what remains of the original flower is an enlargement, a ball, or a sac, that is the ovary of the plant. Most likely it is green in color. This is the place where the female part of the plant, the egg cells called ovules, await delivery of the male sperm cells in order to be fertilized. Once those cells meet up, the ovules develop a hard coating around them, called a testa. This protects the tiny embryo plant that is now developing inside. The fertilized ovule is better known as the seed of the plant. Meanwhile, the ovary that covers the seed develops into the fruit of the plant. Now the true purpose for fruit is revealed: they are to protect the seeds inside until they can get established as the next generation of plants. Ask students to open up the ovary to see how many ovules or seeds are inside. A hand lens will be needed to count the ovules.

10 As a final part of the activity, pass around the peanuts, and ask everyone to open up the shell. Can they make the connection as to what part of the plant they are holding? Before they eat both peanuts inside, ask them to carefully break one peanut open. Use a hand lens to see the inside. What is tucked inside the peanut? Most students should be able to identify the tiny plant nestled in the base of the peanut seed. If the students cannot find one in their first peanut, have them continue to sample them until they do find one.

11 Review the parts of the plant that the class has learned about. Now they are ready to sketch the arrangement of their flower onto the "Floral Map", and answer the questions about each flower part they found. When this is complete, ask students what they think about flowers now that they have investigated one. What do they find are the most interesting features of flowers? How do they feel about picking flowers, about bees and other insects, about the fruit that they eat? The class could even write a story or a poem describing their attitudes and feelings about the processes of pollination and seed dispersal.

Conclusion

"Floral Investigations" gives students an opportunity to observe and get acquainted with parts of a flower. By looking at it piece by piece, they see how the different elements work together to assure the plant's pollination and seed production.

Floral Investigations

ACTIVITY PAGE

Extensions

Extensions to this activity could include the following:

1 This activity coordinates well school curricula about plants, as well as with the "Plant Scavenger Hunt," "Botanical Journal," and "Territories" activities in this chapter. The "Crossword Puzzle" is another fun complement to this activity.

2 In the classroom, ask students to write and illustrate a short story or poem about how a bee, fly, spider, hummingbird, butterfly, moth, or bat helped to pollinate a flower. Another angle on this topic is to describe how a bird, insect, or mammal helped to disperse the seeds from this flower by eating the fruit, or by storing the seeds.

3 In the classroom, older students can explore the origin of plant names. Several good books on this subject are available through libraries and bookstores. By learning why scientists give a plant a particular name, students may better appreciate why a plant is so unique, or so common.

Many plants have scientific names whose origin is Latin or Greek. Students can use dictionaries, encyclopedias, and some botany books to look up the names for insight into the ways that plants function or are classified. The sunflower that grows alongside roads in mid to late summer, for example, has the scientific name of Helianthus annus. These words are Greek: *Helios* meaning "sun"; *anthus* meaning "flower"; and *annus* meaning "year."

This plant, whose flower turns to follow the path of the sun across the sky, and which comes back every year, seems very aptly named. In contrast, other plants are given names from the person or place where they were found. They may want to make a list of several local plant names and their origins in conjunction with the plants that they saw (or will see) on their field trip to Colorado National Monument.

Floral Investigations Worksheet

ACTIVITIES FOR STUDENTS

Sketch/Diagram a flower and all its parts.
Examples for reference are in *Botany for Beginners* and *Botany for All Ages*.

Answer these questions about your flower.

1) How many sepals does it have? _____

2) How many petals does it have? _____

3) What color and shape are the petals? _____

4) Can you see nectar guides on the petals? _____

What color are the nectar guides? _____

5) How many stamens (the male part of the flower) are there? _____

6) Did the anthers have pollen on them? _____

If yes, what color/shape/texture is it? _____

7) How many pistils (female part of the flower) does your flower have? _____

8) What shape is the stigma? _____

Does it have any pollen on it? _____

9) Could you count how many ovules were in the ovary? _____

Territories

ACTIVITY PAGE

Age Level

5th through 8th grades.

Purpose of the Activity

The purpose of this activity is to create the opportunity for students to make a personal connection to the land. Spread out a short distance from one another along a trail, they each have a "territory" to observe silently. Next, they use a small notebook to make inventories of the plants, animals, birds, and insects that live in or pass through their land.

Amount of Time Needed

45 minutes.

Best Location

Any trail is possible for this activity, but Lower Monument Canyon, No Thoroughfare Canyon, or Black Ridge Trails may be best. On them, the group can spread out and have adequate room to "claim a territory" for themselves without being too disturbed by other park visitors. Devils Kitchen and Old Gordon Trails can also be used. The sections after the wash are recommended, so that the group will be away from other foot traffic.

Materials Needed

- ☐ "My Territory Notebook" for each student.
- ☐ Colored pencils or markers for each student.
- ☐ Clipboard for each student.
- ☐ Hand lens for each student.
- ☐ Camera and film.
- ☐ Binoculars (optional).
- ☐ Thermometers (optional).

Territories

ACTIVITY PAGE

Background Information

In our busy, urban lives, children know their neighborhoods, but also travel regularly far from home. Connections to a piece of land with trees, grasses, shrubs, wildflowers and all the associated webs of life are becoming more rare. As people are less dependent on the land for their survival, their roots to it are cut or dwindle. This activity creates a space and a time for children to slow down and get acquainted with a small plot of earth. Once they have become familiar with their spot, they will always be able to return to revisit it.

The structure for this exploration is provided by a notebook of worksheets. Each page focuses on a different subject: trees, plants, birds, animals, insects and spiders, and weather. Students are asked to inventory their "territories", and record their findings with words and drawings.

The role of the teacher and chaperone is to rove among the students making sure that everyone feels comfortable. By taking a photo of each person on their plot of land, the teacher is able to make a permanent record of each student and their "territory". As nothing may be collected in Colorado National Monument, having a photo remembrance has extra meaning for the student.

"Territories" is an activity that is very compatible with a long day hike, or an overnight trip in Colorado National Monument. It stands alone, easily expanding to fill several hours of time. Alternatively, it may be incorporated with other exercises about plants, wildlife watching, or geology. On an overnight trip, students' "territories" can be visited in full sun, at dusk, and even at night. An ideal way to use this exercise is to visit the "territories" in the fall, and again in the winter or spring to observe changes over time.

Territories

ACTIVITY PAGE

How to Do the Activity

Before the field trip, copy the worksheets that follow and assemble them into a notebook type of format. Gather up colored markers for each student to use, or have them bring them from home.

Assembling the "Territory Notebook"

The Notebook is designed to be folded in half. It is also intended for each page to be copied onto the back of another, or "back-to-back". Thus, if the numbering seems off as you first look at it, wait until you actually compile a notebook to decide. The notebook must be used as a whole, or the numbering and arrangement of pages will get out of kilter.

Some tips for assembly:

~ Remember that the cover has a front and a back (pages 1 + 12).

~ Pages 2 + 11 should be copied onto the cover (pages 1 + 12).

~ Copy pages 10 + 3 onto pages 4 + 9.

~ Copy pages 6 + 7 onto pages 8 + 5.

If this organization is used, then the notebook assembly is easy.

Practice on one if you need to. Run off the copies separately, then lay them down as if they were back to back, and you will soon see how they fit together.

Preview the Trail

Be sure to preview the trail to choose the right spot for the activity.

Preferable locations are as follows:

~ A place with little or no cryptobiotic soil crust.

~ A section of trail that is not going to be bustling with other hikers.

~ An area with a mix of trees, shrubs, plants, rock, and good views.

~ A spot that is safe for the children to wander without hazards of cliffs, rockfalls, or other dangers.

~ A location where, as students are dropped off at their "territories", they will feel alone without being so. This is best achieved by a winding or curving section of trail, or one with lots of trees.

Territories

ACTIVITY PAGE

The Value of a Camera

Locate a camera to use. Polaroid cameras are ideal because a picture is immediately available to accompany the activity. However, other types of cameras work very well, and the photos can be incorporated into the notebooks after development. Either the teacher or the chaperone can be the photographer. With a large group, two cameras make the job get done more quickly. Remember to check the camera's battery beforehand, and pack some extra film, just in case!

Step-by-Step Instructions

1 Pass out notebooks, markers, and clipboards at the start of the hike so that the teacher does not have to carry them for the entire trip.

2 When the area for "Territories" is reached, give directions to the students before entering the area. Get out notebooks and go over them page by page so that no one has any questions before they start.

3 Directions for students:

~ Each person will be dropped off from the group along the trail. The area where you are left will be your "territory," your private spot here in the monument.

~ Other students will be nearby, but out of sight, so that each person can have a feeling of the land for themselves. The teacher and chaperones will roam amongst the "territories" so that someone will be checking on you regularly.

~ You will have ___ minutes to explore your "territory." (20 minutes is recommended for younger students, 30 - 40 minutes for older groups.)

~ While you are on your land, first explore it, then find a place to settle in. Take some time to observe what lives on your land. Imagine what it would be like here if this really were your home.

~ Notice any places that you especially like on your land. Can you find birds, animals, signs of animals, insects, and of course, plants and trees? Notice what happens around you as you sit quietly. Be peaceful, and enjoy your "territory".

~ After a while, get out your notebook and make a record of what you see, using the questions on each page as a guide. Several blank pages are also included in case you want to make your own notes. Feel free to draw or write or both.

~ While you are out, a parent will come by and take a picture of you on your "territory". This will become part of your notebook.

~ Have fun, and enjoy this opportunity to get close to a piece of land.

Territories

ACTIVITY PAGE

4 After all preparations have been made with students, and all questions answered, have students line up single file behind the leader. Intersperse parents or chaperones if available; otherwise, the teacher should be at the head of the line, and another adult at the end of the line. Ask everyone to be quiet on the walk in. Head up the trail a ways and leave off the student immediately behind the leader. The rest of the group should pass by that person so that if there is a problem, others will be near to deal with it right away.

5 Drop off the next person in line after the first person is out of sight. A large distance between students is not necessary. The space between is so that they do not interfere with one another.

Drop off the rest of the students one by one in a similar fashion. When the leader has come to the last student, she or he should turn back down the path to check how everyone else is doing. When the first "territory" is reached, the teacher should return once more through the students to the last "territory." The other adult should move through the group taking photos. A minimum of contact should be given by both adults, leaving the students to explore their "territories" in their own ways.

6 If a student is shy or uncomfortable with this activity, try pairing them with another student, or with one of the adults.

7 After the allotted time has passed, the group should gather at a given point, such as half-way along the trail, or at the last "territory". Remind students to leave no sign of their passage on their special spot, other than their footprints.

8 Make sure all materials from this activity, especially photographs, are safely stored in backpacks. Keep water bottles and lunch boxes away from the notebooks to preserve them better.

9 Students will have many things to share and comment upon from this activity. Plan a time for each person to share their story.

Conclusion

This activity helps students to develop their skills of observation, identification, inventorying, and documentation while also making a personal connection to Colorado National Monument that can last a lifetime. Additionally, students have the opportunity to gain self-confidence in a controlled setting by spending time alone on their "territory."

Territories

ACTIVITY PAGE

Extensions

Back in the classroom, "Territories" may be extended into other areas of the curriculum. In math, graphs of plant numbers within plots may be made. Pie charts, percentages, and fractions can all be introduced or interwoven with discussions about what was found on the land. Comparisons between students' plots can be explored. Why would there have been 25% trees on Chris' "territory" while Pat's had 2%? Could it be there was more slickrock on Chris' plot?

Language arts may be incorporated with stories and poems written about their experiences while out by themselves. Research about different animals, birds, or plants could be assigned so that students learn more about specific topics.

Art projects could be developed based on the notebooks. Students could create a painting or sculpture from their sketches made in the field. A mural of the trail could be put together, highlighted by each student rendering a diagram or map of their territory.

Finally, science curriculum alternatives abound in conjunction with this activity. Regular visits to the area could be scheduled so that students could watch their plot of land change over the seasons.

Discussions of erosion, geology, soil building, decomposition, adaptation, and ecology easily interconnect with discoveries made on "territories".

Back Cover
page 12

Front Cover
page 1

My Territory Notebook

Name

Date

Imagine that this is your piece of land.

You will be living here from now on.
This is your “territory.”

You want to find out what else is here:
trees, plants, animals, birds, insects...

Look around. Up and down. In the air.
On the ground. In the trees, the grass,
by the rocks. Look for big things, and
little ones too. Where would you get water?

Find a good place to sit where you can
see your land in all directions. Be very
still. Listen for sounds. A twitter in the
pinyon tree. A scurrying by the rock.
A buzzing near the flower…What else
is out there, besides you?

The pages that follow are for you to
make observations and records about
your “territory”. Some have questions
for you to answer. Others are left open
for you to fill with your own words or
pictures. Discover as much as you can
on your “territory.”

This page is for you to record your own
observations.

Personal Observations

This page is open for you to record in words or with sketches your observations or feelings on your "territory."

Weather

How would you describe the temperature on your "territory"?

☐ Hot! ☐ Pleasant ☐ Cool ☐ Freezing!

Is the wind blowing? ☐ Yes ☐ No

If yes, is it blowing ☐ all the time
☐ in gusts
☐ softly

Do you see any clouds? ☐ Yes ☐ No

If yes, what do they look like?

☐ Thin, wispy — cirrus
☐ Puffy, white — cumulus
☐ Thick, flat, grayish — stratus
☐ Puffy, dark bottom — nimbus
☐ Very puffy , dark — thunderhead

Feel your skin. Is it ☐ dry ☐ moist?

Next, look at some plants. Are they

☐ Droopy? ☐ Wilted? ☐ Shriveled?

Do they seem fresh and upright?

☐ Yes ☐ No

Do they have dew or raindrops on them?

☐ Yes ☐ No

Touch the soil under a plant.

How does it feel?

☐ Hot ☐ Cool ☐ Moist ☐ Dry

Dig down a little bit under the plant.

How does the soil feel there?

_____

Touch different plants, trees, rocks, and soil in your "territory". Can you find the coolest or the hottest place? Where is it?

_____

Trees

Count how many trees over 5 feet in height are on your "territory". _____

Count them a second time, and this time notice how many different kinds of trees there are. Record how many different types of trees you find. (Ex: 4 types of trees found.) _____

Can you identify any of the trees or shrubs?
☐ Yes. ☐ No. If so, list two of them here. ___
_____
_____
_____

How many tall trees do you see? _____
How many short trees? _____
How many dead trees? _____
How many young trees? _____
How many shrubs (bushes) are on your land?
_____

Can you find any signs of animals, birds, or insects using a tree or shrub? Describe them below with words or a sketch.

Draw a map of your territory. This is to help you remember what it looks like. Imagine that you are a golden eagle hovering high above this place. What will you see as you look down? Where is the trail? Where are the rocks? The trees? The shrubs? The animal scat? The ant hill? Use different symbols, numbers, or letters to designate where the different places are. At the bottom of your map, list what the different symbols mean.

Animals

Sit quietly for a time. Be as still as you can. Do you see or hear any animals on your "territory"? _____

Can you tell what kind of animals they are?

_____
_____
_____

Many animals come out only at night, when it is quiet, or when they need food, water, sun, or company. You may not see them, but they are still there. Looking around your land, what kinds of animals do you think might live nearby? _____
_____
_____
_____

Often you will only find signs of an animal's passage. Can you find any of these signs on your land?

- ☐ burrows / dens
- ☐ diggings / scratchings
- ☐ scat (droppings)
- ☐ fur/ hair/ bones
- ☐ tracks
- ☐ leaves / twigs chewed
- ☐ bark peeled off
- ☐ other (you describe) _____

_____
_____

Plants

Count how many flowers that you see blooming in your "territory". Are there?

- ☐ more than 50.
- ☐ more than 15, but less than 50.
- ☐ less than 15.
- ☐ no flowers are blooming.

What colors are the flowers? _____
Is there any sagebrush near you? _____
Are there any cactus on your "territory"? ____
Is there any grass growing on your land? ____
Is there cryptobiotic soil crust near you? _____
Can you find any lichens on the rocks? _____

Check if you can find the following plants:

- ☐ Plant smaller than your hand.
- ☐ Plant with tiny leaves.
- ☐ Plant with hair on the leaves / stem.
- ☐ Plant with no leaves but still alive.
- ☐ Plant growing in the shade of another plant.
- ☐ Plant growing in a crack in a rock.
- ☐ Dead plant.
- ☐ Plant with fruit, berries or seeds.
- ☐ Plant with a swelling /growth on the leaf or stem called a gall.
- ☐ Plant with insect(s) on it.
- ☐ Plant that has been chewed or bitten by an animal or insect.

Birds

Listen for a while. Do you hear any birds?

☐ Yes ☐ No

Count how many different bird sounds and songs you can hear. _____

Look around your "territory". Look up in the air, in trees, and on the ground. Do you see any birds

- ☐ flying?
- ☐ soaring?
- ☐ cleaning themselves (preening)?
- ☐ building a nest?
- ☐ perched?
- ☐ feeding?
- ☐ walking?
- ☐ other?

What colors are the birds that you see? _____

_____

_____

_____

Where do the most birds seem to be?

- ☐ In the air.
- ☐ In the bushes.
- ☐ In the trees.
- ☐ On the rocks.
- ☐ On the ground.

Insects

Do you see any insects in your "territory"?

☐ Yes ☐ No

Are they…

- ☐ crawling?
- ☐ flying?
- ☐ eating?
- ☐ resting?
- ☐ burrowing?
- ☐ hiding?
- ☐ swarming?
- ☐ biting you?
- ☐ other? (you describe) _____

_____

_____

Can you identify any of the insects? (Flies, ants, bees, caterpillars, butterflies, mosquitoes, etc.) _____

_____

Are there any spiders or spider webs that you can spot? _____

_____

Where do most of the insects/spiders seem to be located? _____

_____

_____

Plant Crossword Puzzle

ACTIVITIES FOR STUDENTS

Clues

Down

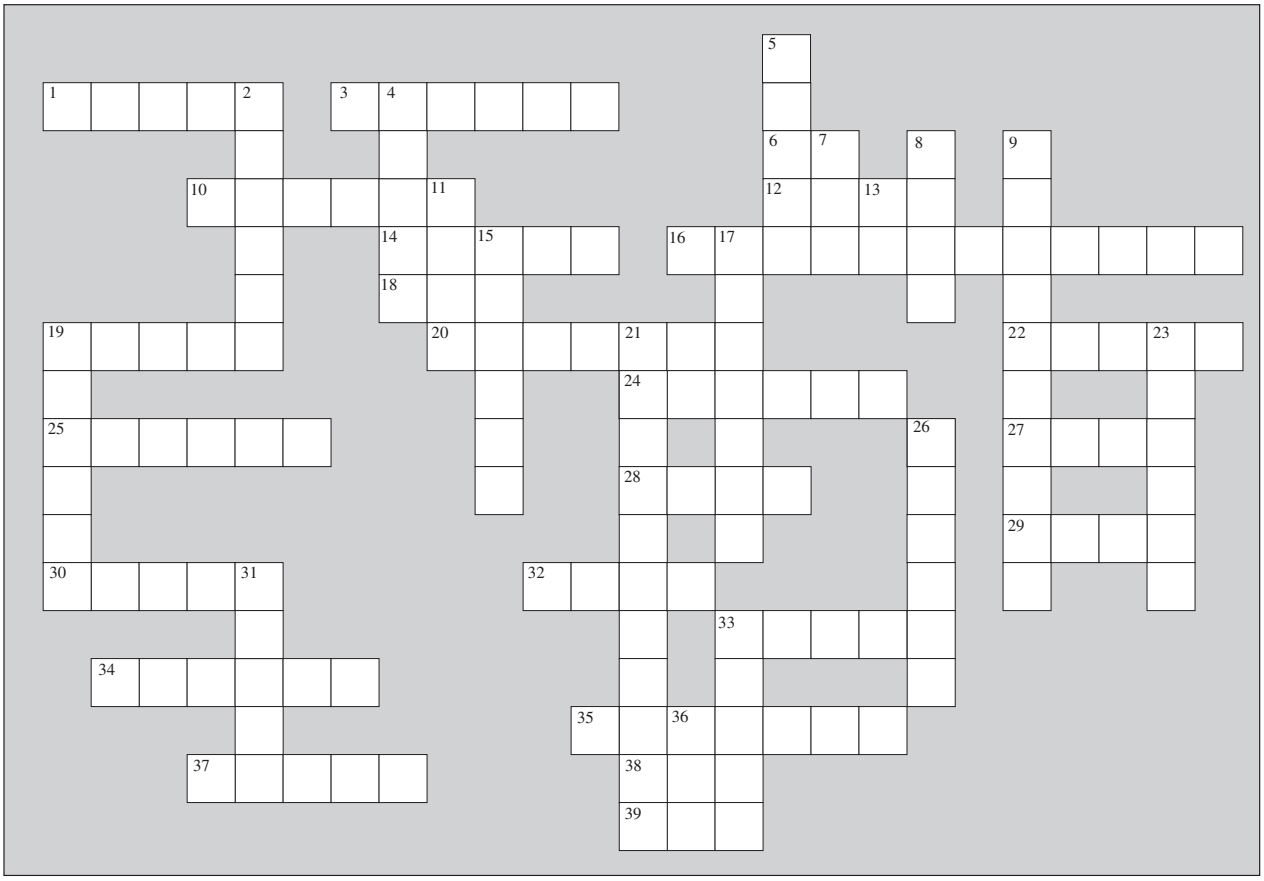
2. What is green and grows on a tree?
4. What is inside the ovary of a flower?
5. What do you call a plant that has lots of tiny fuzz-like growths on its leaves and stems to reflect away sun?
7. What oozes out if you break off the branch of a plant or tree?
8. What do you have to shovel in the winter?
9. What parasitic plant often grows on and amongst sagebrush?
11. What do some people get from the roots of yucca plants?
13. What is the name of the cousin/creature on the Addams Family?
15. What comes off the trunk and limbs of trees?
17. What don't you want to get bitten by in the desert?
19. What has eight legs and might be living in a flower?
21. What bush has yellow flowers in the fall and rabbits like to sit under on hot summer days?
23. What is sharp and pointed on pine trees, and is also used in sewing?
26. What is a favorite landing, eating, and hiding place for bees and insects?
31. Name the tube that goes down to the ovary in a flower. Or "He doesn't dress like anyone else. He has his own _ _ _ _ _ of dressing."
33. Cactus have these to give them shade and to poke you with.
36. A pinyon tree has this inside its cone.

Across

1. A flower has these to attract insects and help them land.
3. Bees often get yellow with this on their legs and heads.
6. A short but useful verb: She _ _ a funny person.
10. This plant has no leaves and swells up when it rains.
12. In the desert, every drop of this is used by plants.
14. A leaf with several rounded or scalloped edges, as an oak leaf, is known as _ _ _ _.
16. A dark crust growing on the surface of the earth made up of lichens, mosses, and fungi.
18. You smell with your nose, not your _ _ _!
19. Plants have these to hold up their leaves and flowers.
20. This rodent stores seeds, nuts, even cactus pads in its home in the rocks.
22. The place where the bark lives; or a word and memory game: " My Grandmother's _ _ _ _ _."
24. The pad where pollen sits, above the filament.
25. Found in flowers, this creature has six legs and three body parts.
27. A good _ _ _ _ for hiking in the desert is to carry plenty of water. This word rhymes with MULE.
28. These insects buzz and sting!
29. This is where plants get moisture, nutrients, and a place to anchor themselves.
30. This plant part extends outward underground, far beyond the base of the tree.
32. Yucca plants are pollinated by these night-flying insects.
33. A tree gives this to birds and animals on a hot day.
34. The nuts from this tree are a favorite of the scrub and Stellar's jays, chipmunks, and squirrels.
35. This tree has scales instead of leaves or needles.
37. A fruit is the second half of the this shrub's name: Service_ _ _ _ _.
38. Leaves have hair and waxy coatings to reflect away the _ _ _ and conserve water.
39. A misspelling of the word, "the".

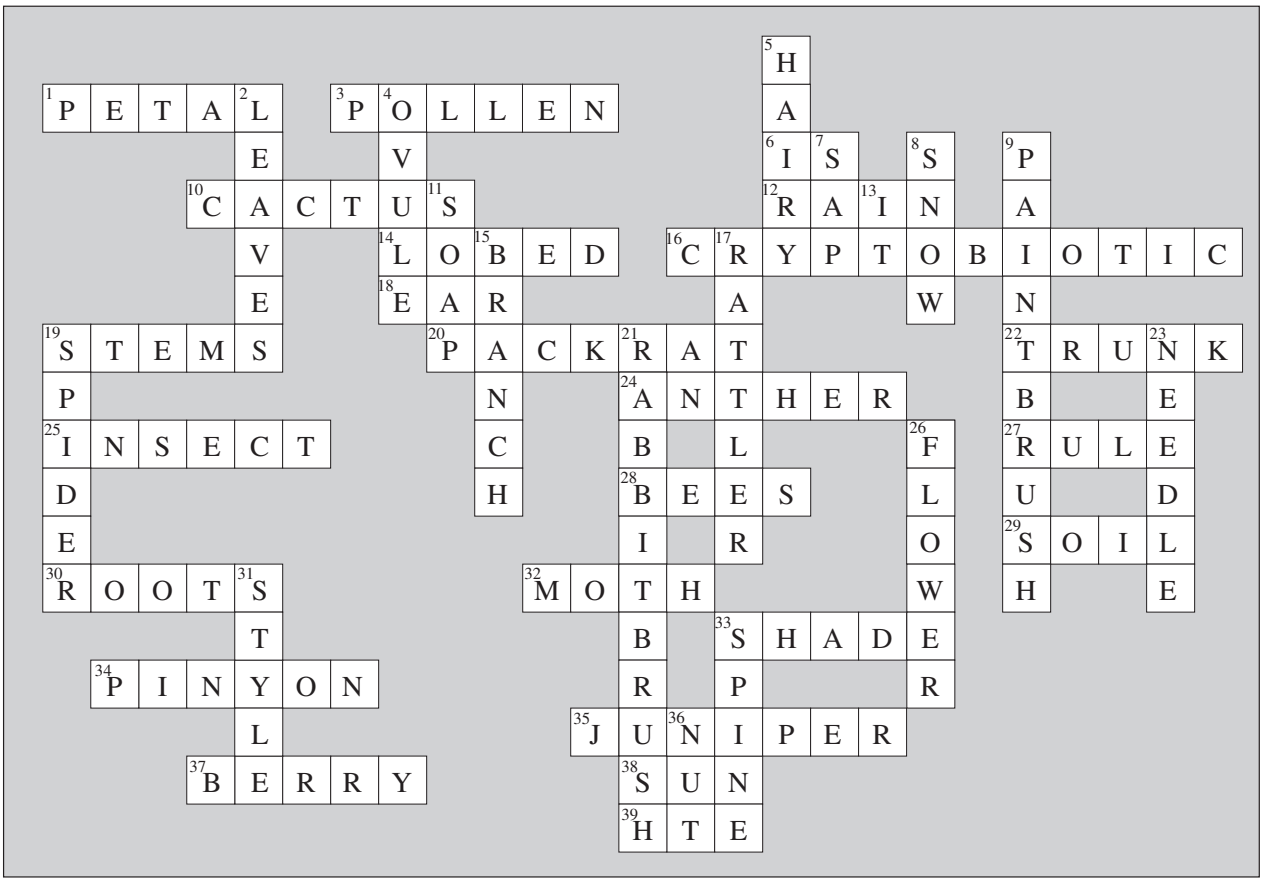
Plant Crossword Puzzle

ACTIVITIES FOR STUDENTS



Plant Crossword Puzzle Key

BACKGROUND FOR **TEACHERS**



Botanical Journal

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Reference Obj. 4.26 4.04 4.07 Thinking Obj. 4.06 4.07 **Standard 2** 4.11 4.13 **Standard 3** 4.04 4.05 4.08 4.10 4.21 **Standard 4** 4.09 4.10 Listening Obj. 4.01 4.02 4.05 4.06 4.08 Thinking Obj. 4.03 4.14 4.16 4.07 4.08 **Standard 5** 5.23	**Standard 1** Writing Obj. 5.07 Reference Obj. 5.04 Thinking Obj. 5.18 **Standard 2** Writing Obj. 5.04 5.05 5.11 5.12 5.13 **Standard 3** Reading Obj. 5.05 5.096 5.09 5.12 Thinking Obj. 5.12 **Standard 4** Listening Obj. 5.02 5.05 5.08 Thinking Obj. 3-5.01 3-5.04 **Standard 5** 5.23	**Standard 1** 6.16 6.20 6.22 6.25 6.37 **Standard 2** 6.17 6.18 6.19 **Standard 3** 6.01 6.06 6.07 6.09 **Standard 4** 6.01 6.04 6.09 6.22 6.25 6.34 6.47 **Standard 5** 6.01 6.05 6.06	**Standard 1** 7.15 7.19 7.22 7.26 **Standard 2** 7.15 7.16 7.17 7.18 7.19 7.23 **Standard 3** 7.04 7.05 7.06 7.08 **Standard 4** 7.08 7.12 7.19 7.22 7.24 7.26 7.28 **Standard 5** 7.08 **Standard 6** 7.12 7.24	**Standard 1** 8.14 8.33 **Standard 2** 8.12 8.13 8.18 **Standard 3** 8.01
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** **2.1** 2.11 2.12 **Standard 3** **3.1** 3.12 **3.4** 3.43	**Standard 1** 1.03 1.04 1.07 **Standard 2** **2.1** 2.11 **Standard 7** 7.05 7.06	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.07 6.1.08 6.1.10 **Standard 2** **2.1** 6.2.01 **Standard 3** 3.1	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 **Standard 2** **2.1** 7.2.01 **Standard 3** **3.1** 7.3.01 7.3.03	**Standard 1** 8.1.05 8.1.07 8.1.10 **Standard 2** **2.1** 8.2.01 **Standard 3** **3.1** 8.3.01 8.3.02 8.3.03

Botanical Journal

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science (cont.)	**Standard 5** 5.05 **Standard 6** 6.03 **Standard 7** 7.04		**Standard 4** **4.2** 6.4.07 **Standard 5** 6.5.03 **Standard 7** 6.7.05	**Standard 4** **4.2** 7.4.01 **Standard 5** 7.5.03 **Standard 7** 7.7.05	**Standard 5** 8.5.03 **Standard 7** 8.7.05 8.7.06
Social Studies	**Standard 2** 4.44 4.46		**Standard 4** **4.1** 6.35 6.36 **4.2** 6.38		**Standard 2** **2.1** 8.18 8.19 **Standard 4** **4.1** 8.40 8.41 **4.2** 8.43
Art	**Standard 1** **Standard 3**	**Standard 1** **Standard 3**		**Standard 1** Art .03	**Standard 1** Art .03

Magic of a Drop of Water

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** 4.06 4.07 **Standard 3** 4.21 **Standard 4** 4.01 4.02 4.05 4.06 4.08 **Standard 5** 4.06	**Standard 4** 5.02 5.05 5.06 5.08 **Standard 5** 5.5.2	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.08 **Standard 2** **2.1** 6.2.01 6.2.02 **2.3** 6.2.04 **Standard 3** **3.1** 6.3.01 **3.2** 6.3.02 **Standard 5** **Standard 6** **Standard 7** 6.7.02	**Standard 4** 7.24	**Standard 4** 8.23
Math	**Standard 1** 4.1.3 **Standard 3** 4.3.1 **Standard 5** 4.5.1 4.5.2 4.5.3b		**Standard 2** 2.1 2.3 **Standard 3** 3.1 3.5 3.6 **Standard 5** 5.1 5.2 5.5 5.6	**Standard 2** 2.1 2.3 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 4** 4.4 **Standard 5** 5.1 5.2 5.3 5.5 5.6	**Standard 2** 2.3 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 4** 4.4 **Standard 5** 5.2 5.2 5.5 5.6
Science	**Standard 1** 1.01 1.02 1.03 1.04	**Standard 1** 1.03 1.05 1.06 1.07 1.08	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.08	**Standard 1** 7.1.02 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08	**Standard 1** 8.1.05 8.1.06 8.1.09

Magic of a Drop of Water

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science (cont.)	**Standard 2** **2.1** 2.11 2.12 **Standard 3** **3.1** 3.12 3.14 **3.4** 3.43 **Standard 6** 6.01 6.02 6.03	**Standard 2** 2.11 **Standard 3** **3.1** 3.12 3.14 3.15 **3.2** 3.22 3.24 **Standard 6** 6.01 6.02 **Standard 7** 7.01 7.02 7.03 7.06	**Standard 2** **2.1** 6.2.01 6.2.02 6.2.04 **Standard 3** **3.1** 6.3.01 **3.2** 6.3.02 **Standard 5** **Standard 6** **Standard 7** 6.7.02	**Standard 2** **2.1** 7.2.01 **2.2** 7.2.04 **2.3** 7.2.05 **Standard 3** **3.1** 7.3.01 7.3.03 **3.2** 7.3.04 7.3.05 **Standard 4** **4.2** 7.4.01 **Standard 6** 7.6.01 **Standard 7** 7.7.01 7.7.02 7.7.03	**Standard 2** **2.1** 8.2.01 **2.3** 8.2.05 8.2.06 8.2.07 **Standard 3** **3.1** 8.3.02 8.3.03 **3.2** 8.3.04 8.3.05 **Standard 4** **4.2** 8.4.03 **4.3** 8.4.04 **Standard 5** 8.5.02 **Standard 7** 8.7.03 8.7.05
Social Studies		**Geography** **Standard 4** 5.18 5.38	**Geography** **Standard 2** 2.1 **Standard 4** **4.1** 6.35 6.36 **4.2** 6.38	**Geography** **Standard 2** **2.1** 7.3.5 7.3.6 **Standard 4** **4.1** 7.59 7.60 **4.2** 7.62 7.63	**Standard 2** **2.1** 8.18 8.19 **Standard 4** **4.1** 8.40 8.41

Extensions of this activity meet Content Standards in Language Arts, Math, and Science for all age groups.

Plant Scavenger Hunt

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Reference Obj. 4.26 Thinking Obj. 4.06 4.07 4.17 **Standard 3** Reading Obj. 4.04 4.05 **Standard 4** Thinking Obj. 4.03 4.07 **Standard 5** Thinking Obj. 4.04 4.06	**Standard 1** Reference Obj. 5.04 5.06 **Standard 3** Reading Obj. 5.05 5.06 **Standard 4** Thinking Obj. 3-5.01 3-5.04 3-5.17 **Standard 5** Reading Obj. 5.01 5.23	**Standard 1** 6.20 **Standard 4** 6.01 6.06 6.22 6.25 6.34	**Standard 1** 7.19 **Standard 4** 7.01 **Standard 6** 7.24	**Standard 1** 8.14 **Standard 4** 8.01 **Standard 5** 8.02 **Standard 6** 8.04
Math	**Standard 1** 4.1.3 4.1.5 **Standard 2** 4.2.1 **Standard 3** 4.3.1 4.3.2 **Standard 5** 4.5.3b	**Standard 2** 5.2.1 **Standard 3** 5.3.1 5.3.7 **Standard 5** 5.5.2	**Standard 2** 2.1 **Standard 3** 3.7 **Standard 5** 5.2	**Standard 2** 2.1 **Standard 3** 3.7 **Standard 5** 5.2	**Standard 2** 2.1 **Standard 3** 3.7 **Standard 5** 5.2
Science	**Standard 1** 1.02 1.04 **Standard 2** **2.1** 2.11 **2.3** 2.31 **Standard 3** **3.1** 3.12 3.14 **Standard 7** 7.02 7.04	**Standard 1** 1.05 1.07 **Standard 2** **2.1** 2.11 **Standard 3** **3.1** 3.11 **Standard 7** 7.05	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.07 **Standard 2** **2.1** 6.2.01 **Standard 3** **3.1** **Standard 7** 6.7.05	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 **Standard 2** **2.1** 6.2.01 **Standard 3** **3.1** 7.3.03 **Standard 7** 7.7.05	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 **Standard 2** **2.1** 8.2.01 **Standard 3** **3.1** 8.3.01 8.3.02 **Standard 7** 8.7.05

Plant Scavenger Hunt

BACKGROUND FOR
TEACHERS

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science (cont.)	**Standard 5** 5.01 **Standard 6** 6.03 **Standard 7** 7.02 7.04 7.05		**Standard 7** 7.7.02 7.7.05 7.7.06	**Standard 7** 7.7.02 7.7.05 7.7.06	**Standard 7** 8.7.02 8.7.05 8.7.06
Social Studies	**Geography** **Standard 2** 4.44 4.45 4.46		**Geography** **Standard 1** **1.2** 7.27 **Standard 2** **2.1** 7.35	**Geography** **Standard 1** **1.2** 7.27 **Standard 2** **2.1** 7.35	**Geography** **Standard 2** **2.1** 8.18

Floral Investigations

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Writing Obj. 4.01 4.08 4.05 4.12 4.07 Thinking Obj. 4.07 **Standard 2** 4.05 4.10 4.11 4.13 **Standard 3** 4.03 4.04 4.06 4.08 4.21 **Standard 4** 4.10 Listening Obj. 4.01 4.02 4.05 4.08 4.03 4.07 **Standard 5** 4.06	**Standard 1** Writing Obj. 5.01 5.05 5.07 **Standard 2** 5.04 5.05 5.10 5.11 5.12 5.13 **Standard 3** 5.3.7 **Standard 4** 5.4.1 **Standard 5** 5.5.2	**Standard 1** 6.20 6.22 6.25 **Standard 2** 6.17 6.18 6.19 6.24 **Standard 3** 6.01 6.06 6.07 **Standard 4** 6.22 6.34 6.37	**Standard 1** 7.19 7.26 7.43 **Standard 2** 7.15 7.16 7.17 7.18 7.23 **Standard 3** 7.01	**Standard 1** 8.14 8.34 **Standard 2** 8.11 8.12 8.13 8.21 **Standard 3** 8.01 **Standard 4** 8.20 **Standard 5** 8.33
Math	**Standard 1** 4.1.3 **Standard 2** 4.23 **Standard 3** 4.3.1 **Standard 4** 4.4.1a 4.4.4 4.4.5 **Standard 5** 4.5.3a 4.5.3b	**Standard 2** 5.2.1 5.2.2 5.2.3 **Standard 3** 5.3.7 **Standard 4** 5.4.1 **Standard 5** 5.5.2	**Standard 2** 2.1 2.3 **Standard 3** 3.1 3,7 **Standard 4** 4.1 4.2 **Standard 5** 5.2 5.6 **Standard 6** 6.2 6.3	**Standard 2** 2.1 **Standard 3** 3.1 3.3 3.7 **Standard 4** 4.1 **Standard 5** 5.2 5.3 5.6 **Standard 6** 6.2 6.3	**Standard 2** 2.2 **Standard 3** 3.1 3.3 3.7 **Standard 4** 4.1 **Standard 5** 5.2 5.3 5.6 **Standard 6** 6.2 6.3

Floral Investigations

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** **2.1** 2.11 2.12 **Standard 3** **3.1** 3.12 **3.2** 3.22 **3.3** 3.33 **3.4** 3.43 **Standard 5** 5.05 **Standard 6** 6.01 6.02 6.03 **Standard 7** 7.02 7.03	**Standard 1** 1.02 1.03 1.05 1.06 1.07 1.08 **Standard 2** 2.11 **Standard 3** **3.1** 3.11 3.12 **Standard 5** 5.04 **Standard 7** 7.05 7.06	**Standard 1** 6.1.02 6.2.03 6.1.05 6.1.06 6.1.07 **Standard 2** **2.1** 6.2.01 **2.2** 6.2.03 **Standard 3** 3.4 **Standard 5** 6.5.03 **Standard 7** 6.7.04 6.7.03 6.7.02	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 **Standard 2** **2.1** 7.2.01 7.2.03 **2.2** 7.2.04 **Standard 3** **3.1** 7.3.01 7.3.03 **3.2** 7.3.04 **3.4** 7.3.09 **Standard 5** 7.5.03 **Standard 7** 7.7.02 7.7.03 7.7.04 7.7.05	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 **Standard 2** **2.1** 8.2.01 **2.2** 8.2.03 **Standard 3** **3.1** 8.3.01 8.3.02 8.3.03 **3.2** 8.3.05 **3.3** 8.3.06 **Standard 5** 8.5.03 **Standard 7** 8.7.02 8.7.03 8.7.04 8.7.05
Art	**Standard 1** **Standard 2** **Standard 3**	**Standard 1** **Standard 2** **Standard 3**	**Standard 2** Art. 04 Art .09 Art .10 Art .11	**Standard 2** Art. 04 Art .09 Art .10 Art .11	**Standard 2** Art. 04 Art .09 Art .10 Art .11

Territories

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts		**Standard 1** Writing Obj. 5.07 Listening Obj. 5.03 Speaking Obj. 5.10 Reference & Study Skills 5.06 Thinking Obj. 3 - 5.18 **Standard 2** Writing Obj. 5.05 5.10 5.11 5.12 5.13 Speaking Obj. 5.01 5.08 **Standard 3** 5.05 5.06 5.11 5.12 **Standard 4** 5.11 5.02 5.05 5.08 5.10 5.11 **Standard 5** 5.23	**Standard 1** 6.20 6.22 6.25 **Standard 2** 6.17 6.18 6.19 6.24 **Standard 3** 6.01 **Standard 4** 6.06 6.09 6.20 6.22 6.25 **Standard 5** 6.01 **Standard 6** 6.06 6.25	**Standard 1** 7.15 7.19 7.22 **Standard 2** 7.16 7.17 7.18 7.23 **Standard 4** 7.01 7.12 7.19 7.14 **Standard 6** 7.24	**Standard 1** 8.14 8.17 8.32 8.33 **Standard 2** 8.12 8.13 8.18 8.21 **Standard 4** 8.01 8.17 8.23
Math		**Standard 3** 5.3.1 5.3.7 **Standard 5** 5.5.2	**Standard 2** 2 .1 **Standard 3** 3.6 3.7 **Standard 5** 5.2 5.6	**Standard 2** 2 .1 **Standard 3** 3.6 3.7 **Standard 5** 5.2 5.6	**Standard 3** 3.6 3.7 **Standard 5** 5.2 5.6

Territories

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science		**Standard 1** 1.05 1.07 1.08 **Standard 2** **2.1** 2.11 **Standard 3** **3.1** 3.11 3.12 3.13 3.14 3.15 **3.2** 3.24 **3.4** 3.43 **Standard 4** **4.2** 4.22 4.25 **Standard 5** 5.04 **Standard 7** 7.05 7.06	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.07 **Standard 2** **2.1** 6.2.01 **Standard 3** **3.1** **3.2** 6.3.01 6.3.02 **Standard 4** **4.2** 6.4.04 6.4.07 **Standard 5** 6.5.03 **Standard 7** 6.7.02 6.7.05 6.7.06	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 **Standard 2** **2.1** 7.2.01 **2.2** 7.2.04 **Standard 3** **3.1** 7.3.01 7.3.02 7.3.03 **3.2** 7.3.04 7.3.06 **Standard 4** **4.2** 7.4.01 **Standard 5** 7.5.03 **Standard 7** 7.7.02 7.7.05 7.7.06	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 **Standard 2** **2.1** 8.2.01 **Standard 3** **3.1** 8.3.01 8.3.02 8.3.03 **3.3** 8.3.06 **Standard 4** **4.2** 8.4.03 **Standard 5** 8.5.03 **Standard 7** 8.7.02 8.7.05 8.7.06
Social Studies		**Geography** **Standard 4** 5.18 5.38	**Geography** **Standard 4** **4.1** 6.35 6.36 **4.2** 6.38	**Geography** **Standard 2** **2.1** 7.35 7.36 **2.3** 7.41 **Standard 4** **4.1** 7.59 7.60 **4.2** 7.62 7.63	**Geography** **Standard 2** **2.1** 8.18 8.19 **Standard 4** **4.1** 8.40 8.41 8.42

Plant Crossword Puzzle

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Writing Obj. 4.12 Study Skill 4.26 Thinking Obj. 4.06 4.07 **Standard 2** 4.11 **Standard 3** 4.01 4.03 4.04 4.05 4.06 4.08 4.21 **Standard 4** 4.07 4.09 4.10 4.11 4.16 **Standard 5** 4.10	**Standard 1** Reading Obj. 5.13 Writing Obj. 5.01 5.05 **Standard 2** 5.03 Writing Obj. 5.04 5.05 **Standard 3** 5.11 5.12 **Standard 4** 5.02 Thinking Obj. 3-5.01 3-5.04 3-5.15 **Standard 5** 5.01 5.23 5.06 5.07	**Standard 1** 6.20 **Standard 3** 6.01 6.06 6.07 **Standard 4** 6.01 6.06 6.20 6.22 6.34 6.35 6.37	**Standard 1** 7.19 7.22 **Standard 2** 7.23 **Standard 3** 7.01 7.08 **Standard 4** 7.42	**Standard 1** 8.14 8.17 **Standard 3** 8.01 8.02
Math	**Standard 2** 4.2.1 4.2.2 4.2.3	**Standard 2** 5.2.1 5.2.4	**Standard 2** 2 .1	**Standard 2** 2 .1	
Science	**Standard 1** 1.04 **Standard 2** **2.1** 2 .11 **Standard 3** 3.1 **Standard 5** 5.01	**Standard 1** 1.03 1.05 1.08 **Standard 2** **2.1** 2 .11 2 .12 **Standard 7** 7.05 7.06	**Standard 1** 6.1.03 6.1.05 6.1.08 **Standard 2** **2.1** 6.2.01 **Standard 3** **3.1** 6.7.05 6.7.06	**Standard 3** **3.1** 7.3.01 7.3.02 **3.2** 7.3.04 **Standard 5** 7.5.03 **Standard 7** 7.7.05 7.7.06	**Standard 3** **3.1** 8.3.01 8.3.02 **Standard 5** 8.5.03 **Standard 7** 8.7.05 8.7.06

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CHAPTER THREE

Wildlife

of Colorado National Monument

Photo from *Through the Eyes of the Children*
by Diane Hirschinger Gallegos and Tope Elementary Students

The Value of Empty Space

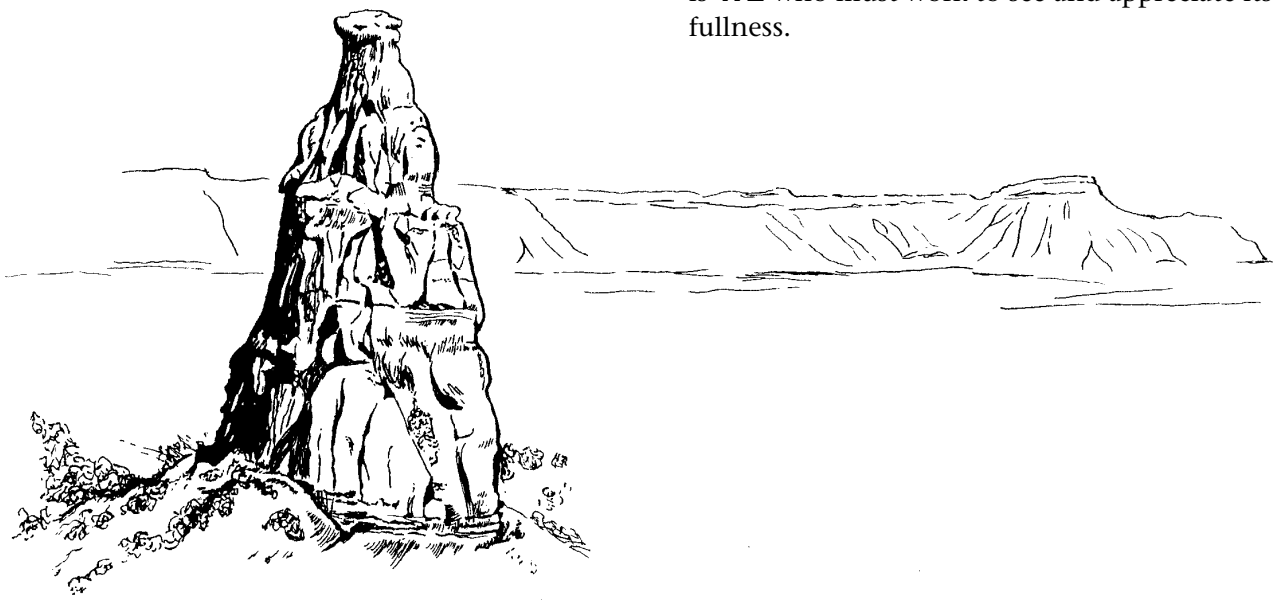
BACKGROUND FOR **TEACHERS**

Television, videos, magazines, and books have brought marvelous imagery and stories about nature into our homes. Zoos and wild animal parks give us close-up views of creatures that we would not normally have the chance to see. As a result, people go to parks and want to capture that excitement and intimacy for themselves. More often, only "empty" space is found. With "nothing going on," they become disillusioned, noisy, and consequently, their own worst enemy.

Empty space is not all that it appears. Numerous dramas are unfolding, yet neither at the speed nor at the level that the humans expect. A harvester ant struggles with a seed twice its body weight, slowly hauling it back to its colony. Clinging to the branch of a juniper tree, a large carpenter bee extends its orange wings to warm itself in the early morning sun. A white butterfly with black speckles on its wings, a Becker's white, flutters above a rabbitbrush, where it lands, extends its tube-like proboscis, and begins to sip nectar from the yellow blossoms. Nearly invisible next to a rock, a jumping spider watches and waits as a small fly walks closer and closer to it. Curled up in its underground burrow, a kangaroo rat sleeps after a busy night of foraging for seeds and plants. A bushy-tailed woodrat completes the resealing of its nest after a piece of it broke off when rocks fell off the nearby cliff. Sitting motionless atop a clutch of five eggs, a canyon wren watches a faded midget rattlesnake slide across the sandstone below her nest. A yellow-headed collared lizard basks on a rock with the legs of the grasshopper it just caught still dangling from its mouth. Perfectly camouflaged in the shade of a boulder, a mountain lion gives itself a bath, slowly licking its back and legs.

This complex web of life may not be visible to a noisy group of children as they rush up the trail. They race past clues and signs of activity that these creatures left behind. The sounds of life going on around them are silenced by their loud voices and stomping footsteps. Only with a relaxed, quiet attitude, a slow to leisurely pace, with many stops to look and listen for signals from the community of rocks, soils, plants, and space around them, will students detect the inhabitants of these lands.

Indeed, there is no "empty" space. Rather it is **WE** who must work to see and appreciate its fullness.



The Ten Most Wanted List

BACKGROUND FOR **TEACHERS**

- Desert bighorn sheep
- Mountain lion
- Bobcat
- Coyote
- Kit fox
- Ringtail
- Mule deer
- Peregrine falcon
- Bald eagle
- Golden eagle

These animals top most visitors' lists of wildlife to see at Colorado National Monument. Yet the likelihood of seeing them is small. What are the reasons for this?

First, while a bird or mammal may be near the trail, they are not as easy to see as you might expect having visited zoos or wildlife parks. Wild animals are busy with daily life: they must seek out food, water, shelter, breed, raise young, and above all, not become food for something else. Their drive to survive may take them throughout their territory, which may be feet, acres, or miles in size. While they may cross paths with you, it is by chance, not by intent. Still, with sharp eyes, a quiet step, and persistence, you may be lucky enough to spot the flick of a mule deer's ear as it chews its cud in the shade of a tall shrub. Or you may hear the call of a peregrine falcon as it flies high above the canyons chasing off a golden eagle. Movement in a bunch of Indian rice grass may clue you in to a desert cottontail nibbling on a stem.

Another reason why these "Top Ten" are hard to find is that they are shy of humans. Many wild animals freeze, hide, or run at the sight, sound, or smell of people. Desert bighorn sheep, mountain lions, and bobcats tend to avoid areas that we inhabit or visit. Even though wildlife populations may be high in a given area, your very presence can send them undercover. While you do not consider yourself to be a threat, birds and animals see you as danger because of your size, noise, movement, and difference from them.

The Ten Most Wanted List

The time of day and weather also make a difference in wildlife watching. Many birds, for example, feed early, in the cool hours of the morning. By 10:00 AM, they are difficult to spot resting in the shade of a tree. Finding turkey vultures, on the other hand, is best in the growing heat of the day. They await rising columns of hot air (known as thermals) to carry them in their search for dead animals on which to feed. Other creatures have different preferences for temperature. Reptiles need external heat to raise their body temperatures to a level optimal for digestion. On a cool morning, or in the deep shade, you may not see any lizards. Later, as the day heats up, they seem to be everywhere, basking on rocks to warm themselves, or darting after spiders and flies. As temperatures peak in the afternoon, reptiles return to the shade of bushes, shrubs, rock crevices, and underground burrows to avoid overheating. Thus, to find wildlife, you need to know something about the animal you want to see in order to time your search with the times when it is most likely to be active.

Predators, such as golden eagles and peregrine falcons, have keen eyesight to help them locate food. They are active during the daytime, or **diurnal**. Since the hours of dawn and dusk are the best for spotting mule deer, foxes, and owls, these creatures are called **crepuscular**. Active at night are the **nocturnal** hunters, ringtails and bobcats. Bats are supremely adapted to nighttime activity, relying on their echo-location capabilities to capture beetles, mosquitoes, and other insects for food. Planning your schedule to correspond with those of the wildlife that you want to see will help you to find them.

Seasons also make a difference when looking for wildlife. Many species of birds leave the region during the colder winter months. Because their food is unavailable, they migrate southward in search of better conditions. While chances of seeing a peregrine falcon diminish in winter, opportunities for seeing bald eagles increase. After nesting in the northern part of the United States, Canada, and Alaska, bald eagles come southward to warmer climates. Some venture along the Colorado River and into parts of the Colorado National Monument. Reptiles and some rodents enter a period of hibernation, or become inactive, during the cold months, and are not seen. Yet deer, elk, and bighorn sheep watching may improve as herds from higher elevations come lower to have better access to food. Some of the best wildlife watching occurs when animal tracks and signs of activity are recorded in winter snows.

Successful wildlife watching involves looking in the right place at the right time. An appreciation of the natural history of the creature also helps the viewer to locate it. You will not find a mule deer up on a canyon wall, nor will you spot a desert bighorn sheep in a backyard nibbling grass. Plan to go to where the animal you want to see lives. Learning about its survival needs and habitat preferences in advance of a field trip will give you a better chance of discovering it.

The Ten Most Wanted List

BACKGROUND FOR **TEACHERS**

Creatures Most Likely To Be Seen

November – February	**March – October**
Common raven	Common raven
Dark-eyed junco	Turkey vulture
House finch	Pinyon and scrub jays
Black-capped chickadee	Swifts and swallows
Mountain chickadee	Desert cottontail
Black-billed magpie	Rock squirrel
Mule deer (tracks)	Least chipmunk
Pinyon and scrub jays	Yellow-headed collared lizard
Desert cottontail	Northern sagebrush lizard
	Gnats, bees, flies, spiders

Finding Wildlife in the Monument: A Trail by Trail Guide

BACKGROUND FOR **TEACHERS**

Colorado National Monument has an abundance of wildlife within its canyons and on its mesas. The guide below lists trails together with birds, reptiles, and mammals that are most likely to be seen along them. The list is divided into three parts: the ***West Side****, including areas closer to the Fruita entrance; the* ***East Side****, including areas closer to the Grand Junction entrance; and* ***Rim Rock Drive****, which traverses the Colorado National Monument. Only the most common species are given. Wildlife listings by season or habitat are not provided. Even with this list, your luck in observing these creatures cannot be guaranteed. So many factors can influence your ability to spot wild animals and birds, including weather, time of day, season, breeding status, migratory patterns, territorial movement, and population fluctuations. Your own state of mind makes the biggest difference. By walking quietly; alone, or in a small group; and by taking* ***plenty of time*** *to stop, look, and listen, your chances of a rewarding view of wildlife are greater.*

West Side

Alcove Nature Trail, Canyon Rim Trail, Window Rock Trail and Visitor Center

Desert cottontail, bushy-tailed woodrat, least chipmunk, rock squirrel, deer mouse, kangaroo rat, coyote, gray fox, skunk, mule deer, bats (many species), pinyon jay, scrub jay, black-billed magpie, raven, canyon wren, rock wren, Bewick's wren, turkey vulture, red-tailed hawk, golden eagle, peregrine falcon, American kestrel, white-throated swift, violet-green swallow, rock dove, mourning dove, common nighthawk, Say's phoebe, ash-throated flycatcher, western kingbird, plain titmouse, broad-tailed hummingbird, black-chinned hummingbird, yellow-rumped warbler, northern flicker, house finch, dark-eyed junco, chipping sparrow, lizards (many species), snakes (many species).

Saddlehorn Campground and Picnic Area

Desert cottontail, bushy-tailed woodrat, least chipmunk, rock squirrel, deer mouse, kangaroo rat, skunk, coyote, gray fox, bats (many species), pinyon jay, scrub jay, black-billed magpie, raven, golden eagle, red-tailed hawk, peregrine falcon, American kestrel, turkey vulture, white-throated swift, violet-green swallow, canyon wren, rock wren, Bewick's wren, rock dove, mourning dove, ruby-crowned kinglet, plain titmouse, bushtit, pine siskin, mountain chickadee, dark-eyed junco, house finch, common nighthawk, northern flicker, American robin, lizards (many species), snakes (many species).

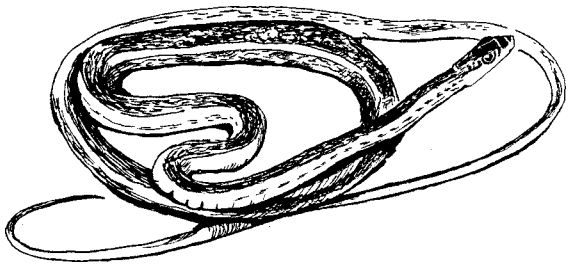
Finding Wildlife in the Monument: A Trail by Trail Guide

Fruita Canyon

Desert bighorn sheep, mule deer, desert cottontail, black-tailed jackrabbit, bushy-tailed woodrat, Mexican woodrat, rock squirrel, least chipmunk, deer mouse, kangaroo rat, gray fox, kit fox, coyote, bobcat, mountain lion, bats (many species), golden eagle, peregrine falcon, American kestrel, red-tailed hawk, turkey vulture, raven, white-throated swift, violet-green swallow, rock dove, mourning dove, canyon wren, rock wren, Bewick's wren, Say's phoebe, ash-throated flycatcher, western kingbird, broad-tailed hummingbird, black-chinned hummingbird, dark-eyed junco, house finch, common nighthawk, northern flicker, American robin, lizards (many species), snakes (many species), amphibians (many species).

Lower Monument Canyon

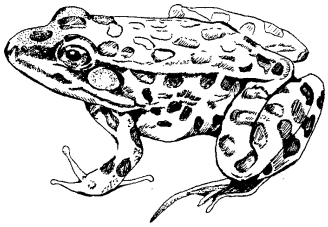
Mule deer, desert cottontail, black-tailed jackrabbit, coyote, gray fox, bobcat, mountain lion, rock squirrel, least chipmunk, bushy-tailed woodrat, Mexican woodrat, deer mouse, kangaroo rat, skunk, bats (many species), peregrine falcon, golden eagle, bald eagle, red-tailed hawk, American kestrel, raven, crow, turkey vulture, meadowlark, American robin, northern flicker, canyon wren, rock wren, Bewick's wren, white-throated swift, violet-green swallow, rock dove, mourning dove, scrub jay, pinyon jay, black-billed magpie, Say's phoebe, ash-throated flycatcher, western kingbird, broad-tailed hummingbird, black-chinned hummingbird, Gambel's quail, house finch, dark-eyed junco, black-throated sparrow, lizard (many species), snakes (many species), amphibians (many species).



Otto's Trail

Desert cottontail, white-tailed jackrabbit, mule deer, mountain lion, bobcat, coyote, gray fox, rock squirrel, least chipmunk, ringtail, bushy-tailed woodrat, deer mouse, kangaroo rat, bats (many species), golden eagle, peregrine falcon, red-tailed hawk, American kestrel, turkey vulture, scrub jay, pinyon jay, black-billed magpie, raven, American robin, northern flicker, canyon wren, rock wren, Bewick's wren, white-throated swift, violet-green swallow, rock dove, mourning dove, plain titmouse, mountain chickadee, broad-tailed hummingbird, black-chinned hummingbird, house finch, dark-eyed junco, lizards (many species), snakes (many species).

Upper Monument Canyon, Coke Ovens Trail



Mule deer, desert cottontail, white-tailed jack-rabbit, coyote, gray fox, kit fox, bobcat, mountain lion, ringtail, rock squirrel, least chipmunk, bush-tailed wood rat, Mexican woodrat, kangaroo rat, deer mouse, bats (many species), peregrine falcon, golden eagle, red-tailed hawk, American kestrel, raven, turkey vulture, American robin, northern flicker, black-throated sparrow, rufous-sided towhee, canyon wren, rock wren, Bewick's wren, house finch, dark-eyed junco, white-throated swift, violet-green swallow, plain titmouse, rock dove, mourning dove, scrub jay, pinyon jay, black-billed magpie, common nighthawk, Say's phoebe, ash-throated flycatcher, western kingbird, yellow-rumped warbler, broad-tailed hummingbird, black-chinned hummingbird, Gambel's quail, lizards (many species), snakes (many species), amphibians (many species).

Finding Wildlife in the Monument: A Trail by Trail Guide

East Side

No Thoroughfare Canyon

Mule deer, desert cottontail, black-tailed jackrabbit, bushy-tailed woodrat, Mexican woodrat, least chipmunk, rock squirrel, deer mouse, kangaroo rat, skunk, coyote, gray fox, kit fox, bobcat, mountain lion, bats (many species), golden eagle, American kestrel, turkey vulture, red-tailed hawk, raven, Gambel's quail, canyon wren, rock wren, Bewick's wren, house finch, rosy finch, dark-eyed junco, black-throated sparrow, chipping sparrow, blue-gray gnatcatcher, ash-throated flycatcher, western kingbird, Say's phoebe, white-throated swift, violet-green swallow, rock dove, mourning dove, common nighthawk, broad-tailed hummingbird, black-chinned hummingbird, plain titmouse, mountain chickadee, black-capped chickadee, American robin, bushtit, lazuli bunting, lizards (many species), snakes (many species).

Note: No Thoroughfare Canyon, with its drainage and waterfalls, is home to a number of amphibians. That this canyon, which appears to be so harsh and dry, should be habitat for creatures whose survival and life cycle are so connected to water is remarkable. **Please, then, be very careful about where and how you walk while visiting this area. Remember, too, that sunscreen, lotions, and oils on your body can pollute these ephemeral waters.**

From April to July, when frogs and toads use the creek and seasonal pools for breeding and egg laying, *please do not disturb or enter the water*! Give the next generation of amphibians a chance to hatch and grow up!

Devils Kitchen Picnic Area, Devils Kitchen Trail, Serpents Trail, Old Gordon Trail

Desert cottontail, bushy-tailed woodrat, Mexican woodrat, black-tailed jackrabbit, least chipmunk, rock squirrel, mule deer, bobcat, coyote, gray fox, kit fox, mountain lion, ringtail, deer mouse, kangaroo rat, bats (many species), pinyon jay, scrub jay, black-billed magpie, turkey vulture, golden eagle, red-tailed hawk, American kestrel, raven, Gambel's quail, black-throated sparrow, house finch, rosy finch, canyon wren, rock wren, Bewick's wren, Say's phoebe, ash-throated flycatcher, western kingbird, plain titmouse, American robin, broad-tailed hummingbird, black-chinned hummingbird, plain titmouse, mountain bluebird, lizards (many species), snakes (many species), amphibians (many species).

Rim Rock Drive

Desert bighorn sheep, mule deer, mountain lion, bobcat, gray fox, kit fox, coyote, ringtail, rock squirrel, least chipmunk, bushy-tailed woodrat, Mexican woodrat, skunk, deer mice, kangaroo rat, bats (many species), golden eagle, peregrine falcon, American kestrel, red-tailed hawk, turkey vulture, raven, canyon wren, rock wren, house finch, dark-eyed junco, black-throated sparrow, white-throated swift, violet-green swallow, mountain bluebird, rock dove, mourning dove, scrub jay, pinyon jay, northern flicker, western kingbird, Say's phoebe, ash-throated flycatcher, American robin, broad-tailed hummingbird, black-tailed hummingbird, lizards (many species), snakes (many species).

Tips for Spotting Wildlife Along the Trail

BACKGROUND FOR **TEACHERS**

~ Dress to blend in with your environment.

~ Talk quietly — or not at all — on the trail.

~ Practice the skills of quiet walking, stalking, and using your peripheral view in order to "see" more in the environment around you.

~ Periodically stop and stand still for several minutes. Let your eyes roam, as new levels of activity reveal themselves.

~ Use your ears to locate sounds of wildlife along the way. Often the song of a bird, a rustling in the grass, or the clatter of hooves on gravel are your best clues that creatures are nearby.

~ Scout for good shelters or hiding spots near the trail. Also look closely around places where water or moisture has gathered.

~ Scan for tracks in dust, wet sand, and snow to indicate routes traveled by wildlife en route to shelter, water, or food. When two habitats come together, or where one type of plant life transitions to another, pay special attention. Called "ecotones", these are rich places for wildlife to feed and live.

~ Look for scat.

~ Not all wildlife is at the surface. Check by rocks, dead trees, roots, branches, leaves, grass. For example, circular depressions in sandy areas beneath rock overhangs may be the hiding places of ant lions, while swellings on leaves or stems can hold eggs and larva of tiny wasps. If you pick up a rock, be sure to carefully replace it exactly as it was. It may be the roof or the shade prized by some small creature.

~ Remind students in advance of their field trip that if they do discover wildlife, they should remain still, not rush forward, and not attempt to capture them. Humans are VERY frightening for wild animals, and no one wants to scare or harm them accidentally. Besides, it is much more interesting to observe wild creatures in their own habitat, going about their daily activities, than to entrap them in a cage, terrarium, or hand. Be aware, many wild animals will bite, scratch, or kick if handled, and many more problems can result from that.

~ Plan your hike with the season, time of day, and temperature during which the wildlife that you want to see will be active. Early morning and evening are good times for wildlife watching. In the heat of the day, many animals, birds, and reptiles are not visible as they rest and stay cool in trees, shrubs, rock crevices, and other shelters.

~ If possible, preview the trail you will hike several days beforehand, and at approximately the same time of day as you will bring the class. Alone, and moving at your own pace, scout out nests, dens, places to see wildlife that you can then refer to with your group. This is particularly useful if the class does not see any wildlife. At least, you can create a tale about the lizard that was right here, just the other day.

~ Binoculars and a camera will enhance your views, and help to record your discoveries.

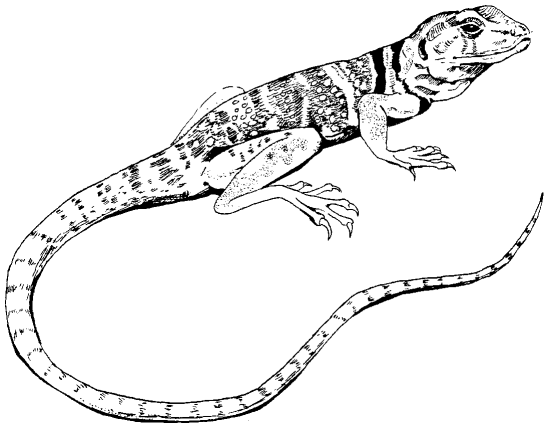
~ The leader must keep the group together and safe at all times. Students should not straggle along the trail, or run ahead of the leader. The pace should be that of the slowest member, thereby assuring that all students make the hike successfully. Either the teacher or a chaperone should be at the head of the line to do pathfinding. Another adult should be designated to be the last person along the trail to assure no one is left behind.

~ *Above all, remember that wildlife watching is not a fast-paced activity.* It should be undertaken with leisurely purpose, so as to experience as much as possible. Be aware that you are the visitor, and this is the home of wildlife. Treat them, and the land, with respect.

Wildlife Biography: Lizards

BACKGROUND FOR **TEACHERS**

Lizards are members of the Reptile Class, which also includes turtles, crocodiles, snakes — and dinosaurs! Of the 3750 known species of lizards found around the world, the majority live in warm places, such as rainforests and deserts. Some, however, live high in the mountains, and a few inhabit islands. In our region, approximately twenty different types of lizards are known. They may be seen climbing on rocks or trees, skittering across the soil, or basking in the sun.



Regardless of their location, lizards have many features in common:

~ Their bodies are shaped like long, thin cylinders.

~ Their tails may be longer than their bodies, and are used for holding on to things, and for balance. Fat reserves are stored in the tail, which helps lizards to survive periods without food. Some species have weak zones in the vertebrae of their tails. This is a defense mechanism: when a predator attacks, the tail detaches quickly and keeps on wiggling independent of the body. The predator is distracted while the lizard escapes. Even though tails will regrow, the new ones are connected by cartilage only, and look different from the original one.

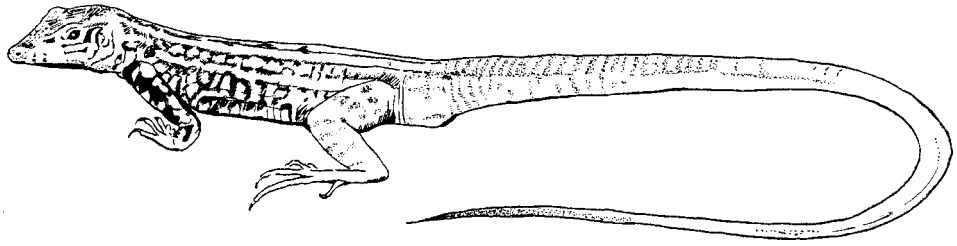
~ Most lizards have four legs, but several species have no legs. Legless lizards move much like snakes, and slither across the ground. In our area, the lizards all have four legs, with five toes, and claws for gripping. In sandy areas, the passage of lizards is marked by four footprints, topped by holes from the claws. Between the feet is a line left by the tail.

~ Scales, made of the same material as our fingernails, cover their bodies, and act as protection from the elements as well as from predators. The color of scales can vary tremendously, from the bright yellow and green of the yellow-headed collared lizard, to the mottled brown and grays of the well camouflaged sagebrush lizard. The arrangement, size, and shape of scales on lizards distinguishes them both from snakes and from each other.

Wildlife Biography: Lizards

BACKGROUND FOR **TEACHERS**

- As lizards grow, they form a new covering of scales underneath the old. The old scales drop off in small pieces. This contrasts with snakes, which often shed their skin in a single, long piece. It is not possible to tell how old a lizard is by how many times it has shed its skin. A lizard's growth is influenced by temperature, and food availability and quantity. In times of plenty, a lizard grows more quickly than in times of scarcity.
- The eyes of lizards are located on sides of their heads. This enables them to see up, down, and to the side at the same time, a very useful adaptation for spying potential food, approaching predators—or even school groups.
- Lizards have ear holes on the sides of their heads. They can hear quite well, in addition to picking up vibrations through the ground or rocks where they are perched.
- The teeth of lizards are sharp and shaped like cones, for use in catching, grasping, carrying, and killing their prey. Many lizards can — and will — bite if you try to pick them up.
- Lizards, like other reptiles, do not regulate their body temperatures internally. They are "cold-blooded". In order to warm up, they must absorb heat from their surroundings. This is why you will see lizards "basking" in the sun on rocks. When they get too hot, they retreat into the shade of tree roots and rock crevices to cool off. By moving around this way, they are able to maintain a nearly constant temperature.
- Some lizard species defend a territory in which they feed, bask, and take shelter. When another lizard, or even a human, enters its space, the lizard will push up and down on its front legs. While this looks like the human equivalent of push-ups, for the lizard it is an effort to show dominance and appear formidable by moving aggressively. Some species flash their colorful sides, while others puff out their throats.
- Lizards differ from amphibians by their combination of scales, ear holes, claws, and ability to survive away from water.



Wildlife Biography: Lizards

BACKGROUND FOR **TEACHERS**

Lizards of Colorado National Monument

Yellow-Headed Collared Lizard

Body: 4 to 5 inches long, with a tail that is up to ten inches long, This species is perhaps the most unusual looking creature in the Colorado National Monument, and certainly the brightest in color. It is also impressive in size. The head, chin, and toes are yellow, with a variety of brownish to blackish markings. The neck area has two wide black stripes that look like "collars", and contrast with the underlying yellow tone. The back and tail of the lizard can be speckled green to brown to gray-green. The skin may look loose and wrinkled on the body. Insects, spiders, and other lizards are its food, which it captures by running fast, jumping, even standing up and balancing on its hind feet alone.

Leopard Lizard

Body: 3 1/2 to 12 inches long, with a large head, and a tail at least as long as its body. The underlying color is gray to brownish. Numerous small spots and crossbars contrast with the rest of the body. Grasshoppers, crickets, beetles, spiders, small rodents, even other lizards are its food. Even though it is a fast runner, most often it lies in wait for its prey in the shade of a bunchgrass, shrub, or low plant. Pregnant females have an orange stomach.

Eastern Fence Lizard

Body: 1 3/4 to 3 1/2 inches long, with a tail of the same length as the body. Beige to gray-brown in color, its back is marked with pale crossbars and chevron-like patches of dark brown, black and white. Its scales are quite coarse compared with other lizards. Common in the park, adult lizards have patches of sky blue color on the sides of their abdomens, and two separate patches on the sides of the throat. Found in a variety of habitats from under rocks, to rock crevices, to bunch grass, to small shrubs, it eats spiders, insects, millipedes, and, yes, be glad, ticks!

Wildlife Biography: Lizards

BACKGROUND FOR **TEACHERS**

Northern Sagebrush Lizard

Body: 1 3/4 to 2 3/4 inches long, with a tail of the same length as the body. This lizard looks like an eastern fence lizard, but is clearly smaller, and has fewer scales on the neck and thigh areas. The scales appear to be more smooth than those of the fence lizard. The underlying color is gray-brown, with light and dark stripes on the back and sides. It feeds on small insects, spiders, even scorpions, that it catches on the ground.

Western Whiptail

Body: 2 1/2 to 4 1/2 inches long, with a very long, thin tail that may be twice the body length. Whiptails are found in open or slickrock areas, with low shrubs, and occasionally near water. Scales are yellow to beige to brownish, with a speckly pattern on the back, fading to more of a checkerboard on the tail. The neck has distinctive folds of skin, and a large ear hole is visible. The hind legs are bigger than the front, and the toes are large and clawed. These lizards run in a jerky way with their tails "whipping" back and forth. Unlike other lizards, whiptails rove in search of prey, and do not defend a territory.

Side-blotched Lizard

Body: 1 3/4 to 2 1/2 inches long, with tail of the same length of body. This brownish lizard has a characteristic blue-black patch on its side, just up behind the front leg. The rest of the patches or "blotches" are variable, from dark brown to gray to yellow and buff. Scales are smooth, and the neck has a fold of skin on it. This lizard is very common in sandy, rocky washes, near grass and shrubs. It spends most of its time on the ground, and eats insects, spiders, scorpions, and sowbugs!

Plateau Striped Whiptail

Body: 2 1/2 to 3 3/4 inches long, with a very long, thin tail that may be twice the body length. Young of this species have a bright blue colored tail, which fades to pale blue in adults. Its dark brown to black back has six or seven stripes that run the length of its body. An interesting fact is that no males are known from this species of whiptail.

Wildlife Biography: Mountain Lion

BACKGROUND FOR **TEACHERS**

Mountain lions, also known as pumas and cougars, live in mountainous areas, foothills, mesas, and canyons of the western United States. While Colorado National Monument is a likely place for them to be found, they are rarely spotted by visitors. One reason for this is that mountain lions are very secretive and solitary by nature. As predators, they capture their food using the element of stealth and surprise. If they do not want to be seen, you probably will not see them. Even though they grow to between six and eight feet in length, and can weigh between 100 (female) and 130 (male) pounds, hairs between the pads of their large feet act to cushion their passage, and help them to move silently. Colored brownish-red to tawny-beige on their backs, mountain lions are also well camouflaged on the desert soils and rocks. Their solid coloring gives them their Latin name, ***Felis concolor****, or "cat of the same color". Only movement of their dark-tipped tails, which may reach thirty inches in length, might give them away.*

Another reason you do not see mountain lions is that their territories extend from five to over thirty square miles. They have been reported to travel twenty-five miles in one night. Deer are their preferred food, although elk and small rodents will also be eaten. Once prey has been located, the mountain lion will hide and wait for the right moment to spring out for the kill. One deer will feed the lion for about a week. After gorging on the meat, the lion may hide the carcass under leaves and brush to save for later. Between feedings, the lion rests and stays well hidden. The combination of solitary, stealthy hunting behavior; long periods of rest; and a large territory makes it uncommon to cross paths with mountain lions.

In recent years, as more people have moved into the foothills, mountains, and rural parts of the of the west, stories of human-lion interactions have begun to circulate. Occasionally pets have disappeared mysteriously, lion tracks have been found close to homes, and lone persons on trails have been attacked. Some attacks on humans have been reported, often by young or yearling lions that have recently been sent from the company of their parent to live out on their own. These incidents are not the result of extra aggressive mountain lions. Rather they are the consequence of more human pressure and ventures into lands that were once the sole turf of these secretive cats. Who has more right to be there? And at what cost? These are hard questions, for which there may be no simple answer. No doubt such concerns will linger for years to come.

Wildlife Biography: Mountain Lion

BACKGROUND FOR **TEACHERS**

If you come upon a mountain lion, some words of caution are in order. Contrary to previous advice that you may have heard, wildlife biologists from the Colorado Division of Wildlife now recommend the following procedure:

~ In areas where you think a lion might be, make a lot of noise, talk, or sing as you go. Your loudness may scare away the lion.

~ If you come upon a lion, **STAY CALM!** Talk to it firmly and with composure. Move slowly.

~ **Stop where you are, or BACK away slowly. ALWAYS FACE THE LION. DO NOT RUN!**

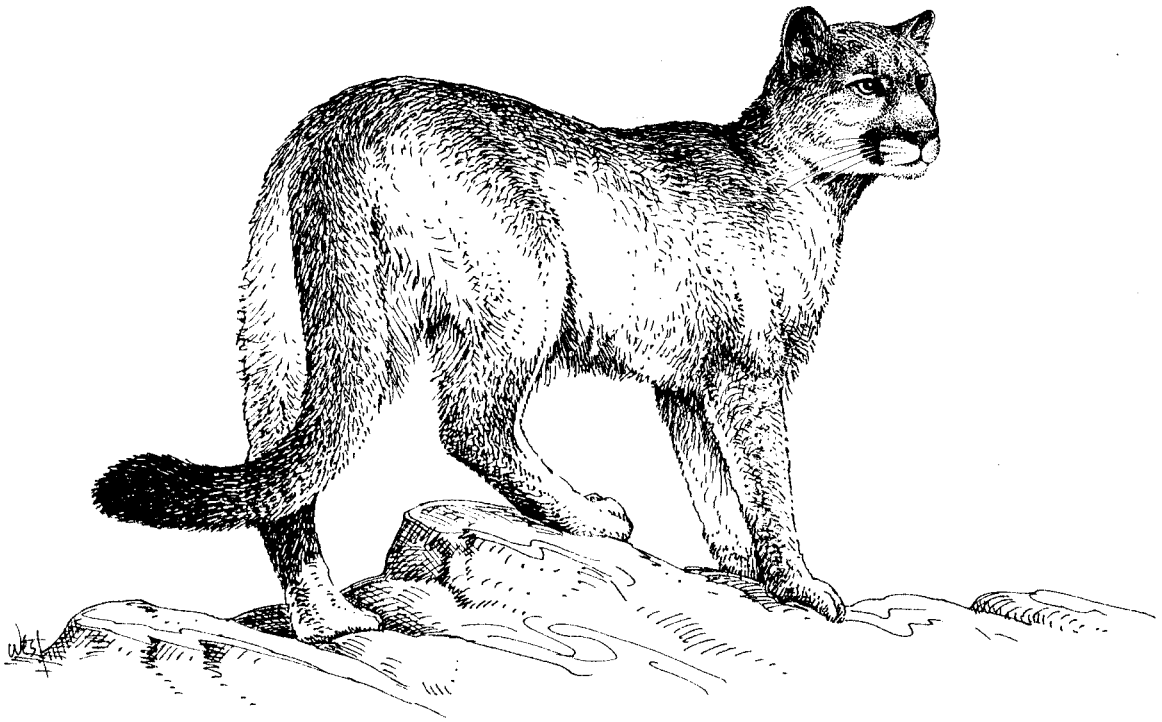
~ Raise your arms above your head to appear as large as possible. If you are carrying a backpack, lift it up above your head to seem even bigger. Your size may intimidate the lion.

~ If the lion behaves aggressively towards you, throw stones, branches, whatever you can get your hands on **without bending down or turning your back**.

~ If it does attack, **FIGHT BACK!** Lions can be driven away by your resistance.[1]

Other cautions apply as well. Always let someone know where you are going, and when you will be returning. Use your head, and be careful. Mountain lions do not have to be a source of fear, but as we humans extend the boundaries of our lives to increasingly overlap with the territories of lions, more encounters can be expected.

[1] Armstrong, D. *Lions, Ferrets, and Bears: A Guide to Mammals of Colorado.* Colorado Division of Wildlife pamphlet. p. 43.



Wildlife Biography: Bats

BACKGROUND FOR **TEACHERS**

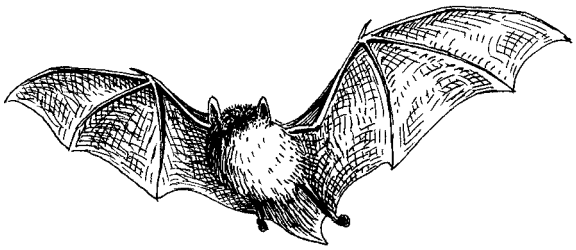
Of the 1000 or more bats worldwide, seventeen kinds reside within Colorado. Seven species are known to inhabit the rock alcoves, crevices, and a variety of other shelters at Colorado National Monument. They are: little brown myotis, long-legged myotis, small-footed myotis, western pipistrelle, big brown bat, Townsend's big-eared bat, and pallid bat. These flying mammals have fascinating physical features that help them to flourish here and throughout the world.

One of the most unique characteristics of bats is their ability to "see" well with little or no light. Many scientists have studied how bats, which are active at night, can find such small and moving objects as insects without running into anything. Although no one fully understands how they are such masters of the darkness, what is known is:

~ Bats have good eyesight, and can see well during the day or the night.

~ Bat can echo-locate. They have the ability to emit high frequency sounds, which bounce off an object and return to the bat with information about the object's location. This can be done on the wing as well as while perched.

~ Bats also have good hearing. Their large ears can gather sounds as tiny as an insect's footstep, and amplify them, which helps the bat to locate its prey.



Other physical features of interest are bats' wings. They are made of skin that stretches across their forearm to their elongated second through fifth fingers, and then goes to their back legs and tail. Outspread on the downbeat and retracted on the upbeat, these wings enable bats to swoop, sweep, dart, and flap through the air with remarkable precision and speed.

Also of interest is a bat's unusual ability to survive cold temperatures. Bats are most active during the warmer months of the year. In winter and when temperatures drop, they enter a type of torpor, or period of inactivity, lower respiration, heartbeat, and body temperature. In rock crevices, holes in trees, even recesses in people's homes, they survive on fat reserves that they develop during the warmer months. In the spring, they give birth to live young, which cling to the parents until they are old enough to take flight themselves.

In spite of these marvelous adaptations, and many benefits to humans and the environment, bats are still a source of fear, misinformation, and mythology. Some myths worth dispelling for students are:

~ **Bats are not blind.** Even though the ears are the more prominent feature on many bats, they do have eyes, and can see quite well.

~ **Bats do not fly into hair, or near you, for the purpose of harming you.** Bats are not really interested in humans. Rather they are interested in surviving, which may entail hunting for insects in the vicinity of people. Should they come near, it is most likely because lights around houses, porches, or buildings attract insects, their main source of food. In addition, bats' highly developed ability to echo-locate allows them to know that humans are much too big to eat. Thus, most bats want to stay away from you as much as you may want to stay away from them!

Wildlife Biography: Bats

BACKGROUND FOR **TEACHERS**

Small-footed myotis

- **Bats will not drink your blood.** Only one species of bat, the vampire bat, does drink blood, and that is from cows and other hoofed mammals. No vampire bats are known in the United States. Rather, they are found in Latin America. Local bats, such as the little brown myotis, have been estimated to eat as much as one-third of their body weight in thirty minutes.[1] Just imagine what a colony of bats does to the insect population in one night! We should appreciate one of the valuable functions that bats perform in nature, keeping the number of insects in balance.
- **All bats do not carry rabies.** Even though all mammals are capable of being infected with rabies, they are not necessarily carriers of it. The same is true with bats. Less than one-half of one percent of all bats contract rabies, and those that do frequently die without causing any kind of harm. Many years ago, incorrect information about bats and rabies was widely publicized, creating this misconception. Many studies have since confirmed that bats pose no higher risk than other mammals for this disease.[2] Public health records show the odds of humans dying due to disease from bats to be much less than one in a million.[3] However, it must be noted that people should always be careful about touching any unknown animal, whether it be domestic or wild.

Fossils of bats have been found that date back over 50 million years ago. Thus, the enduring success of these unusual looking winged mammals speaks strongly for their importance in the environment. Tropical bats, which often feed on fruit, are considered critical to the pollination and seed dispersal of rainforest plants. Some crops, such as bananas, dates, figs, avocados, and mangoes depend almost entirely on bats for their survival. Locally, bats consume thousands of mosquitoes, moths, beetles, flies, gnats, and other insects, which helps to keep insect populations in check. Bats have established a unique niche for themselves, which helps them to survive in a diverse range of environments, from the rainforests of the tropics to the canyons and mesas of the Grand Valley.

Now, it is our turn to help bats. We must protect them from population declines due to habitat destruction, pesticide spraying, and unnecessary death due to misinformation. A specific act that school children can take is to build and hang bat houses. Kits for these simple to construct wooden structures are widely available, and numerous books about bats contain information on them as well. Local nurseries, garden centers, bird-feeding, toy, and nature supply stores may also carry information or plans for helping care for these flying marvels.

[1] Armstrong, D. *Lions, Ferrets, and Bears: A Guide to the Mammals of Colorado*. Colorado Division of Wildlife pamphlet. 1993. p. 9.

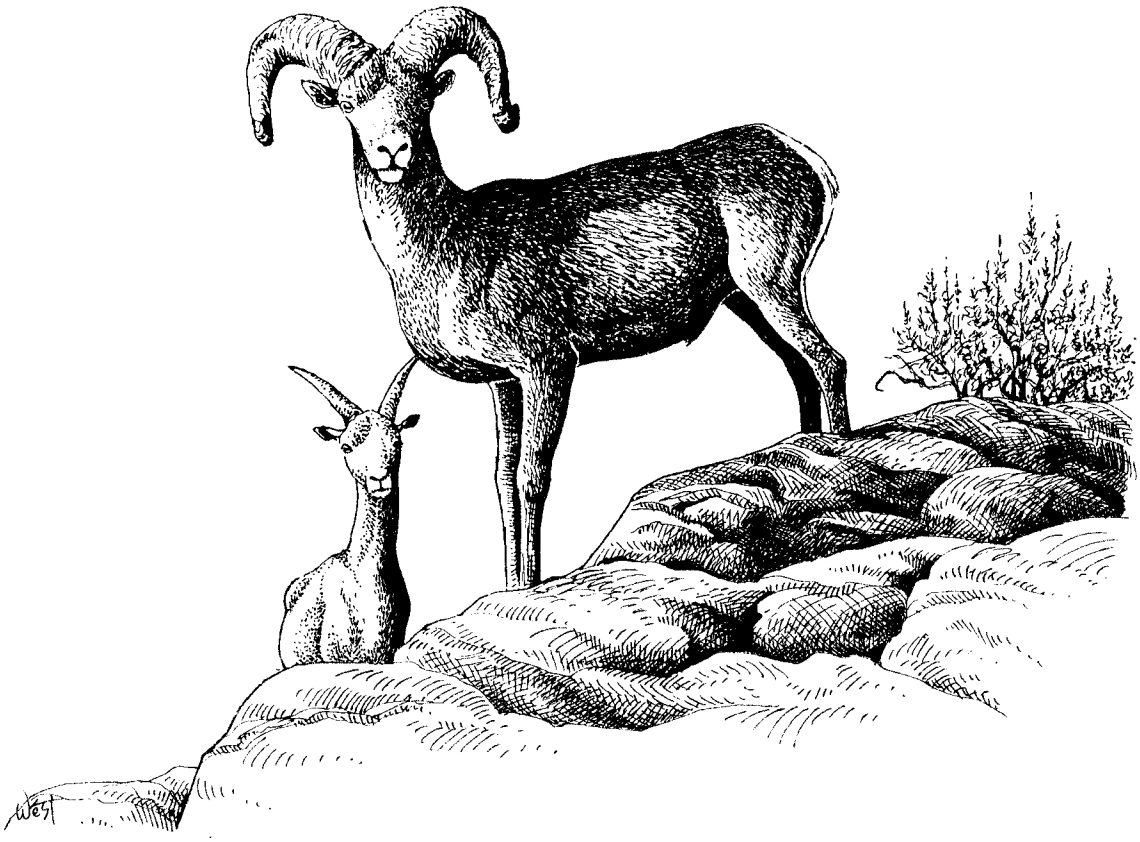
[2] Tuttle, M. *America's Neighborhood Bats*. University of Texas Press. Austin, Texas. 1988. p. 18-19.

[3] Ibid. p. 24.

Wildlife Biography: Bighorn Sheep

BACKGROUND FOR **TEACHERS**

Colorado is home to two species of bighorn sheep, the Rocky Mountain bighorn, and the desert bighorn. The state mammal is the Rocky Mountain bighorn, or Ovis canadensis. However, the desert bighorn resides at Colorado National Monument . Several small populations of these fascinating animals were introduced here from Nevada and Arizona between 1979 and 1981. These transplants have adapted to life in the canyons and mesas, and appear to be surviving in the local conditions. Frequenting rugged slopes and with only a sparse growth of trees, desert bighorns travel along the cliffs of the Wingate Formation, and the talus slopes below. Some groups are also found on the slopes of the Kayenta Formation above the Wingate cliffs. In the winter, they are more often seen on south-facing canyon walls, while in the summer they linger on cooler north-facing walls. Springs, potholes, and sources of water may also be good places to see them in the early morning. Even if you were to approach the bighorns, because of their keen eyesight, they are likely to see you coming and quickly disappear. Nervous around humans, even other grazing animals, they prefer to live in isolation in remote areas and wilderness.



Wildlife Biography: Bighorn Sheep

BACKGROUND FOR **TEACHERS**

Part of the Bovidae Family, bighorn sheep are related to cows, sheep, goats, antelope, and bison. However, in looks and size, they more resemble deer. Bighorn sheep have brown to gray colored fur, pale abdomens, and cream-colored rumps. Standing 2 1/2 to 3 1/2 feet high, 5 to 6 feet long, and weighing 75 - 150 pounds (female), 125 - 275 pounds (male), they have a sturdy build. While deer have antlers that are shed and regrown each year, bighorn sheep have permanent horns that grow annual rings. On males, the horns form large 360 degree coils, which can weigh as much as ten percent of overall body weight. Female horns are much smaller, and arch back from the forehead in a quarter moon shape. Because male sheep can butt horns as part of the seasonal fall rut, their heads have specially developed cushions of spongy material to absorb the shock. Their crania, or skull bones, are also extra thick. Another unique feature of bighorn sheep is their hooves. The outer edge is rigid and stiff, whereas the inside is more soft and rubbery. This combination enhances both their traction and their balance, enabling them to make a living on the seemingly sheer canyon walls and talus slopes where little else competes with them for food.

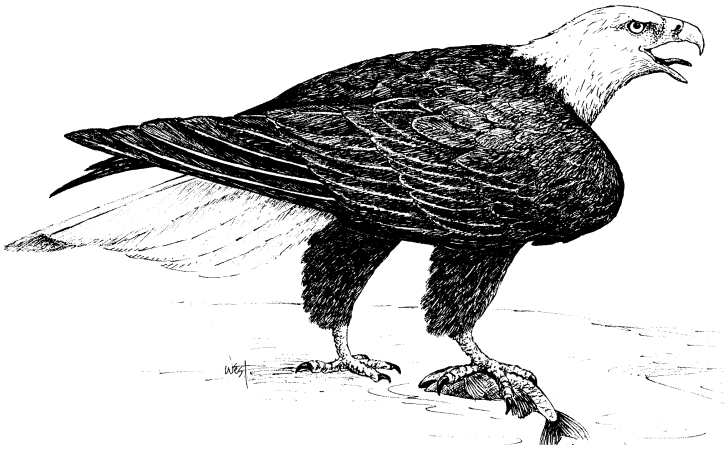
During the summer months, bighorn sheep often separate into male and female groupings, as they seek out sedges, grasses, and small plants for food. By fall the groups reunite, and the males may determine dominance through head butting. While that activity is one for which they are most famous, it does not occur that often. Where duels for harem control are common among elk and deer, this is not so in bighorns. Usually the ram with the biggest horns is dominant, and challenges to its position are few. Although the dominant male may mate, other males are also successful. Lambs are born six months later, when plants are at their greenest.

Look for these graceful, but shy, animals in Fruita Canyon.

Wildlife Biography: Eagles

BACKGROUND FOR **TEACHERS**

Colorado National Monument has two resident eagles: the bald eagle in the winter, and the golden eagle year-round. Both of these large birds of prey may be seen over the mesas and canyons. The golden eagle nests in the area.



Bald Eagles

Bald eagles are the second largest bird of prey in North America. Their wings extend out six to eight feet, and their 36 to 43 inch body can weigh up to twelve pounds. Only the California condor is larger. Its scientific name is "*Haliaeetus leucocephalus*", or "sea eagle with the white head". Its dramatic profile and contrasting black and white colors have made it one of our nation's symbols since 1872. Identifying features of this striking bird are:

~ **Large wings, and wing span.** Seen from below, eagle wings look like planks sticking out from the body. When soaring, the profile is flat, with the wings sticking straight out from the body. This differs from the turkey vulture, with whom it can be confused. Turkey vultures carry their wings tilted up in a V-shape. To gain elevation, the eagle flaps its wings heavily and slowly.

~ **Dark brown to black colored body and wings.** Mature eagles are a solid dark color on their entire body, except for the tail and head, which are white. Immatures may have patches of white on underwings, even a mottling of white on the body. Bald eagles do not reach adult plumage until four years of age, when the white head and tail become distinguishing features. As immatures, bald eagles are easily confused with adult golden eagles.

~ **Head is large in proportion to the body.** In addition, the beak, eyes, and feet are yellow in mature eagles. Immatures have a brownish beak, pale yellow eyes, and yellow feet. Legs are unfeathered in mature bald eagles, contrasting to mature golden eagles which have feathers to their toes.

~ **Commonly found along rivers, lakes, and coastal areas.** Because the bald eagle is primarily a fish eater, it is usually seen near water. Locally, look for bald eagles perched on cottonwood trees or dead snags along the Colorado, Gunnison, and Dolores Rivers.

Feeding habits of the bald eagle may take it far from water, and hence over the monument. On these forays, it will eat squirrels, prairie dogs, rabbits, muskrats, and waterfowl. Occasionally it may be found alongside highways and roads scavenging road kill. While bald eagles are found across much of the United States, they visit the Grand Valley region most often in winter, and head north for nesting in the spring and summer. Bald eagles are protected under federal and state laws (as they are on the Endangered Species List). They were given this protection when their numbers declined due to hunting and poaching; disturbance at nest sites; loss of nesting trees and habitat; and pollution of their food by pesticides and lead shot that caused thinning of egg shells and lack of reproductive success. With federal protection, bald eagle populations have stabilized, and even increased in some parts of the country.

Wildlife Biography: Eagles

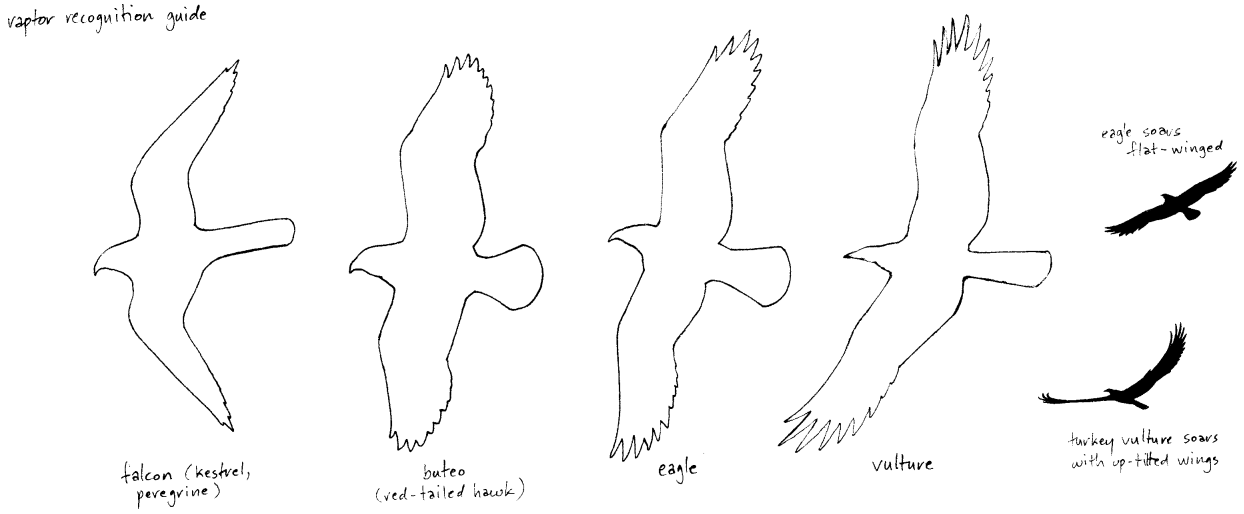
BACKGROUND FOR **TEACHERS**

Golden Eagles

Golden eagles differ from bald eagles in three ways. First, they are not fish eagles, and frequent drier places that may be far from water. Mesas, plains, cliffs, desert, grassland, even mountainous areas are their preferred habitat. They are year-round residents of this region. A second difference is in looks. Not only is the golden smaller in size, with a wingspan of 6 to 7 1/2 feet, and a body weight of 8 to 12 pounds, but its colors are not the same. The mature golden eagle has dark brown feathers over its entire body and wings, with a small patch of white periodically visible at the base of the tail. Only in good light and up close may the golden feathers at the nape of the neck be seen. Confusion between immature golden eagles and adult bald eagles occurs because of tail and wing feathers. Immature goldens have a bright band of white followed by a band of black at end of the tail. This small amount of white reminds watchers of the entirely white tail of the mature bald eagle. Causing further confusion is that both immature golden and bald eagles may have patches of white at the base of their feathers that create a dappling effect.

Rabbits are the preferred food of golden eagles, with prairie dogs, ground squirrels, marmots, and snakes also being taken. Skunks and birds of prey are also consumed. Little evidence has been found to support the contention that livestock is at risk from golden eagles. Nesting takes place throughout western Colorado from March to June. Cliff ledges and alcoves with open areas below for hunting are preferred. The same nest, or nesting area, may be used again and again.

For school groups doing wildlife observations or bird studies, care should be taken in identification of large birds of prey over Colorado National Monument. In addition to the challenges of identifying bald and golden eagles, it may be difficult to identify red-tailed hawks and turkey vultures from a distance. Therefore, before you shout that you have spotted a bald eagle, pay attention to the following things: what season it is; the bird's proximity to water; the size of its wings and wingspan; the profile of its wings (flat versus tilted upwards); the feathering on its legs; and, lastly, the location of white on its head, tail, and underside of wings.



Wildlife Biography: Peregrine Falcon

BACKGROUND FOR **TEACHERS**

Peregrine falcons are among Colorado's biggest celebrity wildlife. Not only have they been on federal and state Endangered Species Lists, but thanks to the dedicated work of the Peregrine Fund and agencies like the Colorado Division of Wildlife, peregrine falcons are making a comeback! With captive breeding programs, careful manipulation, and reintroduction efforts, the number of these magnificent fliers is recovering from a 1972 low. Now, wild peregrine falcons return to Colorado National Monument annually to nest and raise their young. If you are lucky, you may be able to see or hear one of these birds of prey. Begin your search at the Visitor Center, where National Park Service personnel can direct you to the best places for observation.

Peregrine falcons are one of the few birds that may be found worldwide. Thus far, Antarctica and polar regions seem to be the only areas without them. In spite of this broad distribution, peregrines are not found in large numbers in any one place. Rather they are known as long distance fliers, capable of migrations from the end of South America to the northern tip of North America. Such ranges are not surprising given that their prey, small birds and waterfowl, also migrates between their northern breeding grounds in the summer and their southern feeding and winter ranges. Only in mild climates does the peregrine occasionally linger year-round.

Recognizing a peregrine falcon is easy close-up, but much more challenging at a distance. Up close, the body is about the size of a crow, 15 - 20 inches tall. Wingspan is 43 - 46 inches. Distinguishing features are:

~ **Black to slate-colored head and neck.** This coloring is reminiscent of a black "helmet" that may extend to cover crown, cheek, and back of neck.

~ **Black "mustache" or malar stripe.** A line of black extends from the eye down onto the neck. The contrast of the bright white of the bird's chin and neck with the black stripe creates the impression of a drooping handlebar mustache. Some studies suggest that this stripe protects the bird by confusing potential predators with which dark spot is really the eye.

~ **Yellow on cere (membrane that covers over the nostril area).** The bill itself is slate to gray in color. It is short but sharply hooked.

~ **Back is blue-gray,** while chest is whitish with brown to blackish horizontal crossbars.

~ **Tail is striped horizontally across.** On the top, the tail is light gray with dark bars; on the underside, tail is paler with contrasting dark stripes.

~ **Feet are yellow.** The long, powerful toes, and sharp talons are used to capture and kill prey in flight.

Wildlife Biography: Peregrine Falcon

BACKGROUND FOR **TEACHERS**

If students see a peregrine at all, it may well be flying off at a distance. Flight characteristics to look for are the long, pointed wings whose shape differs from the rounded tips of eagles and hawks. Wingbeats are rapid, strong, and fast, more similar to pigeons than other large birds of prey. The tail seems long in proportion to the body. The light underside of the bird contrasts with dark back and head. Unlike the prairie falcon, the peregrine does not have dark patches in the wing axils, or wing "armpits". One of the easier methods for spotting a peregrine is to listen for its call, which is best described as a series of harsh, rasping screams. These are often heard near the nest area, when the young are begging for food, or as the adults are giving a chase.

Peregrines are superbly adapted to life on the wing. Records show them going up 1000 to 3000 feet in the air when hunting, and then stooping (plunging downwards head-first) at speeds up to 100 - 200 miles per hour to capture prey. In experiments, peregrines have been found to spot potential prey over 1/2 mile away! Both of these features are necessary, for these birds identify, kill, and carry off their prey in the air. Birds such as doves, pigeons, starlings, blackbirds, swallows, jays, magpies, sparrows, and waterfowl are favored. Bats, insects, and some rodents may also be eaten. In turn, their only predators—aside from humans and pesticides—are great horned owls and golden eagles.

Colorado National Monument is ideal habitat for peregrine falcons, which prefer cliffs surrounded by open country for nesting. They also prefer proximity to water, such as rivers, drainages, even the ocean, because of the plentiful birdlife found there. All these conditions are met within the Colorado National Monument, and luckily for the bird-watching public, the peregrines have been nesting and visible for several years. With respect and no disturbance, Colorado National Monument peregrine falcons will be successful in replenishing their population for many generations to come.

Wildlife Biography: Swifts and Swallows

BACKGROUND FOR **TEACHERS**

Even though swifts and swallows are part of different bird families (swifts are in the Apodiidae Family, and swallows in the Hirundidae Family), they are often spoken of as one group. Indeed, there are many similarities:

~ Both birds eat flying insects such as bees, flies, beetles, moths, butterflies, gnats, and mosquitoes. They catch their food while in flight, using their wide mouths like nets to scoop bugs out of the air.

~ Both birds are outstanding fliers, capable of great speed for their size. In addition, they stay in the air for long periods of time, and carry on many of their daily activities while on the wing. These include: feeding (catch flying insects); drinking (sipping water from the surface of rivers and lakes while in flight); even courting and copulating.

~ Both birds have bodies that are aerodynamic, and ideally suited for flight. Their bodies are streamlined and cylinder-like. Their wings are proportionally long and pointed. Their legs are short with tiny feet. The swift even has a flattened skull to promote the passage of air up and over the head and body, much the way modern cars are built with front ends that arc or slant up from the bumper to minimize wind resistance.

~ Both birds, and their young, may enter periods of torpor, a state where body temperature, respiration, and heartbeats are all lowered, leading to a period of inactivity, in bad weather or cold temperatures.

~ Both birds are found world-wide, and both undertake long migrations in the fall.

~ Both birds occupy the same areas at Colorado National Monument. Distinguishing them makes a fun challenge for classes doing bird studies and wildlife observation.

White-Throated Swift

Seventy-three species of swifts are found world-wide, with four known in the United States, and one at Colorado National Monument. The white-throated swift is a six to seven inch long bird, whose wingspan is approximately twelve inches. Its scientific name, *Aeronautes saxatalis*, derives from the Latin word "*aero*", meaning "air"; and "*nautes*", meaning "sailor". This is an excellent description for this bird, which, in profile, looks like an archery bow, with wings arced back for optimal aerial speed and minimal resistance.

Identifying features of the white-throated swift besides this arched profile include its style of flight. The swift flaps its wings very rapidly then swoops and soars in a glide. This alternating, "twinkling" pattern of wingbeats and sailing is easy for bird-watchers to recognize even from far below. Swifts are also known as one of the fastest flying birds in North America.

A second identifying feature of swifts is their color. They are black on their crowns, backs, sides, wings, and slightly forked tails. Yet their undersides, including the chin, belly, breast, and throat, are white, giving these birds their name. The white is widest below the beak and narrows in a V-like shape to the base of the tail. On the swift's sides, near the tail, are two distinct patches of white that are separated from the white of the belly by the black. These flash distinctively in the light as the bird moves.

Wildlife Biography: Swifts and Swallows

Violet-Green Swallow

Of the seventy-nine species of swallow around the world, eleven are found in North America, and eight in the West. Four species are known to visit Colorado National Monument, the violet-green swallow being seen most often. It is five to five and one-half inches long, slender and a fast and agile flier. Like the swift, its main source of food is insects, such as flies, bees, mosquitoes, gnats, leafhoppers, ants, grasshoppers, and moths. However, while the swift soars high above the canyon walls and mesa tops, the swallow may be observed at a range of elevations. It may go back and forth across open areas, ponds, rivers, trees, and shrubs, almost touching the water as it flies, diving and climbing as it chases its prey. This style of flying is one way to identify the violet-green swallow, and gives it its scientific name, *Tachycineta thalassina*, which is Greek meaning "swift-moving."

Color is another way to identify the violet-green swallow. Iridescent, glossy purple-green on the back, wings, head, and tail contrasts with bright white on the chin, neck, breast, and belly. White also comes up onto the face, with the effect of an apostrophe encircling the eye. Thus, the swallow's body seems to be put together from two different parts, a dark upper and a light bottom. Like the white-throated swift, with whom it often associates, the swallow has two crescent-shaped patches of white that curve up on either side of its rump, and seem almost to meet over the tail. In the swallow, these patches are solid white from the belly up onto the back, whereas the swift has a contrasting black line of feathers between the white of the belly and the white of the patch. These color patterns are visible even as the birds are flying overhead.

Wing-shape also distinguishes the violet-green swallow. The wings extend from the slender and cylindrical body with a very recognizable elbow-like bend in them. This is quite unlike the smooth bowed shape of the wings of the swifts.

The different songs of the swallow and swift can be a final aid in separating the two species.

If a twitter, sounding like *chit-chit-chit, tweeeeet, tweeeeet*, is heard, the violet-green swallow is more likely. If the song descends in scale and volume, from a loud *gee* to a softer one, as if the singer ran out of breath, *GEEEE-Gee-gee-ge-ge*, then the white-throated swift is the singer. Even without clearly seeing the birds, their voices, and often the elevation at which you hear them (the swift up high in the sky, the swallow down lower), can assist the bird-watcher in recognizing these two marvelous fliers.

white-throated swift (above)/violet-green swallow (below)

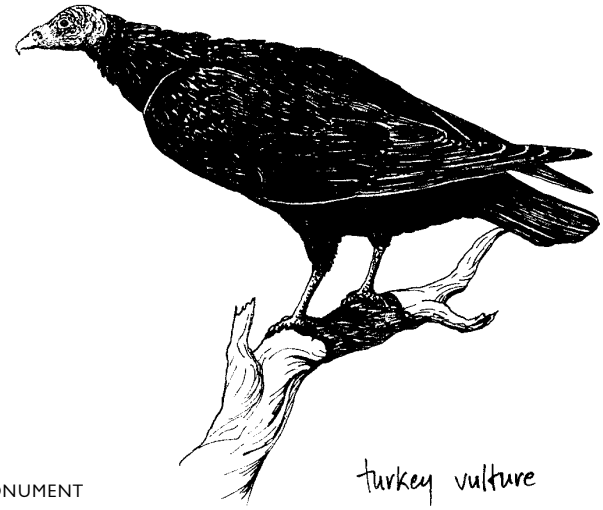
Wildlife Biography: Turkey Vultures

BACKGROUND FOR **TEACHERS**

Bird-watching at Colorado National Monument is always enhanced with a view of a turkey vulture soaring across a mesa top, or swooping in and out of shadows along a canyon wall. These large, graceful birds are related to California and Andean condors, and not to eagles or hawks, with whom they are often confused. In spite of their similar size (26-32 inch body, 6 foot wingspan) to birds of prey, a closer look at vultures reveals many differences.

Foremost, turkey vultures are scavengers, subsisting on carrion, or dead animals. They do not chase, capture, and kill their food as hawks, falcons, and eagles must. Instead, with excellent eyesight and a keen sense of smell, they scan the countryside for dead, even putrefying, carcasses. A vulture that sights a potential meal signals its discovery by descending rapidly to the ground. Soon after, other vultures sail in to join it. With beaks designed for tearing and crushing, they feast on the flesh, organs, and bones of whatever rodent, reptile, bird, cow, or domestic animal that has been found. Roadkills are a common food source. The reputation of the vulture is not always what it deserves to be. Where hawks and eagles are viewed as predators high on the food chain, turkey vultures are often seen as the garbage collectors and undertakers of the bird world. And yet, fossil remains of vultures are known to go back 65 million years, suggesting that the success of these unusual birds demonstrates the importance of their unique role in nature.

As carrion eaters, turkey vultures have several features that distinguish them from hawks and eagles. First, they have no feathers on their heads, a useful adaptation for birds that regularly stick their heads inside rotting corpses. That way, parasites, bacteria, insects as well as clean-up are all minimized. The skin on their heads is either red in adults, or sooty-black in immatures. Because the skin color resembles that of a turkey, the name "turkey vulture" is very appropriate.



Wildlife Biography: Turkey Vultures

BACKGROUND FOR **TEACHERS**

A second feature that is unique to the Vulture Family is a more highly developed sense of smell than in many other bird species. Turkey vultures are known to be sensitive to specific scents, such as that of methane gas, which is released during the decomposition process. Along the Alaska Pipeline, oil workers pay attention to turkey vultures, because a release of methane gas around a well head or on the pipeline will draw these birds in.

A third feature of turkey vultures is the way they fly. Because fewer dead animals exist in nature than live ones, the vultures' next meal may be several days off. Thus, conservation of energy is very important for these birds. Much of their routine is timed to benefit by the growing heat of the day. Air warmed by the sun rises into the atmosphere in what scientists call "thermals." Turkey vultures catch these rising air currents, which carry them high into the sky without the vultures having to expend much energy of their own. Higher up, winds carry them along, so that they merely spread their wings, steer with their tails, rock back and forth for better views, and soar across miles of countryside with little physical effort. Thus, while some birds are active early in the day, vultures are easiest to locate as the day warms up, about mid-morning. A bird that is circling upwards in the sky, or that floats along the canyon rim; one that rarely flaps its wings; one that holds them upwards in the shape of the letter "V"; one that seems to rock back and forth to steer, is most likely a turkey vulture. Eagles and hawks will also soar, but they flap their wings more often, and do not rock back and forth.

A fourth feature of turkey vultures is their color and shape. They are sooty-black to dark brown on their tails, backs, heads, and underbodies. Their wings are two-toned: the flight feathers are gray, while the wrist and axillary feathers match the rest of the bird. No other bird in our area has this wing pattern. In profile, the head seems recessed in behind the wing. Eagle and hawk heads tend to extend beyond the wings.

The time of the year is important for spotting turkey vultures at Colorado National Monument. Because of cold winter temperatures here in the Grand Valley, these birds migrate southwards from October to April. A sign of spring is the return of these graceful, soaring scavengers.

Developing Wildlife Viewing Skills

ACTIVITY PAGE

The following activities have been developed as warm-up exercises for viewing wildlife on field trips. They may be done in either the classroom or the schoolyard setting. The lessons center on techniques to improve observation and listening skills, key elements in successfully locating wildlife. Practicing these activities may result in students achieving surprisingly good views of wildlife on their visit to Colorado National Monument.

What Do I See?

When visiting a natural area or wilderness, many people overlook wildlife that may be nearby. The reason for this is the narrowness of their focus. They may be thinking about something else besides what is around them, humming, or talking with a companion. Many people simply watch the path itself as they travel as quickly as they can to a specific destination. By widening their view, many hikers are rewarded with new discoveries. They may, however, have to slow down!

In his book, *Field Guide to Nature Observation and Tracking*, naturalist and author Tom Brown, describes an exercise to reduce this "tunnel vision." He writes:

> "...Spread your arms wide to the sides and behind you. Then, wiggling you fingers bring your hands gradually forward until you detect the first flicker of movement out of the corners of your eyes. That is your field of view laterally. (With most people, it is nearly 180 degrees!)
>
> "Next, wiggle your fingers while holding one hand high over your head and the other at your side. This is your vertical field of vision, an almost 150- to 160-degree arc from ground to sky…"

Before trying this exercise in the classroom, hide ten or more objects belonging to students along the walls, shelves, window ledges of the room. Preferably they should be along two opposing walls. When the students come in, ask them to stand at their desks, and try Tom Brown's exercise to enhance peripheral vision. Afterwards, keep the class standing and facing one of the walls with nothing hidden. Tell students that they must remain facing this wall, and may NOT turn their heads. Hidden on the edge of their vision, on the two opposite walls, are ten items that do not belong where they are hidden. Together the group can find them. No one person should be able to find them all. Working together, they can discover all the items. The teacher confirms and writes down on the chalkboard what is found by using peripheral vision.

After this exercise, students will be more aware of the potential range of their view, and tend to use it more readily. Suddenly, things that were not noticed before, small movements of grass, the fluttering of leaves, even the twitch of a cottontail's ear as it hides under a nearby bush, are now detected. The potential of the class for discovering wildlife along the trail is greatly improved by using Tom Brown's exercise to reduce "tunnel vision".

Developing Wildlife Viewing Skills

ACTIVITY PAGE

Camouflage Dressing Hide and Seek

This experiment teaches the value of blending in with the environment when people want to see wildlife. To get close to animals without being seen, duck hunters and wildlife photographers hide in blinds, or shelters made of materials that blend in with their surroundings. Bow hunters dress in camouflage clothing so that they go undetected by their quarry. Students seeking views of wildlife can benefit by similar environmental dressing. To appreciate the effectiveness of camouflage, try this version of the long-time favorite, "hide and seek".

To begin, find a wooded area, a field of tall grass, or an open space with bushes that is near to the school. Take students there, and discuss where the boundaries are. Next, explain that you are going to play a game of hide and seek to see who is the hardest to find. While you close your eyes and count out loud to 30, the students are to find hiding places. When you open your eyes, whomever you spot and name must come and stand with you. The only rule is that the group must stay within the given (and very clear) boundaries. A helpful consequence to assure boundaries are respected is that if the boundaries are violated, the group automatically and immediately returns to the classroom.

When everyone is ready, turn your back and count slowly and loudly to thirty (or more, at your discretion). Students should run and hide. As the giggles die down, warn the hiders that you are going to turn around. Slowly turn and survey the area. See how many students you can find. Frequently, those in brightly colored clothes, or colors contrasting with the area around them, are the ones easiest to spot. Call those students in. Let them join you in the hunt for the rest of the group. The last person to be found is "it" for the next round. After playing this game several times, students will be noticeably more difficult to locate.

At the end of the game, analyze what happened. (You can designate a recorder who lists the first and last five students to be found. An interesting math and graphing problem could be to compare clothing color with ease of discovery.) Why was the person wearing neon pink so easy to locate? Why couldn't anyone find the person dressed in beige or brown? Whom do you think the animals at Colorado National Monument would have spotted the fastest? Why would that person be so easy to find? What could he/she do to prevent this in the future? Conclude with the suggestion that for the field trip students try to dress to blend in with their environment, and therefore help everyone to be able to find more wildlife.

Developing Wildlife Viewing Skills

ACTIVITY PAGE

Nature's Hiding Places

On the chalkboard, make a list of places where the students think that mammals, birds, reptiles, amphibians, and insects would find shelter. Options to include are: piles of dead brush; high in a tree; close to the trunk of a tree; in the crevice of a rock; underneath a rock; in a bunch of tall grass, etc. Match wildlife with each setting. Remind students that these are the kinds of places to look for wildlife on their field trip to the Colorado National Monument. After discussing the need for shelter, list the other needs that wildlife has, such as food, water, community, and space. List other places in which students would expect to find wildlife, including water holes, pinyon trees, berry patches, rock ledges with good views, etc.

Developing Wildlife Viewing Skills

ACTIVITY PAGE

Quiet Voices

(NOTE: You should enlist the support of your fellow teachers before you conduct this experiment on their classes. You may also want to pick a teacher who does not mind a little disruption.)

Before these experiments, choose one or two people to be the "counters". They will not participate in the activity. Instead their job is to count the number of people who respond in the other classrooms.

Part 1

Begin by taking your students outside to a place near the window of another classroom. Tell them to look in the window, and begin jumping up and down, waving their arms, and making a lot of noise. The "counter" watches the students in the classroom, and tallies exactly how many people look away from the teacher to pay attention to these silly antics at the window. Discuss the students' observations of the consequences of their noise-making. What would happen if the group came by a second time? Would more of the class respond, or less?

Part 2

As the group approaches a second classroom, tell students to walk slowly and quietly past this window. Again the counter focuses on the number of heads that turn to observe what is happening outside. What was the response of the second class. How was it different from the first group? Compare and contrast the two methods of travel for the group. How are wildlife affected by noisy versus quiet groups? What can be learned for ways to travel on the field trip? Which kind of voice is going to help the group to see more wildlife?

Developing Wildlife Viewing Skills

ACTIVITY PAGE

The Ears Have It

This exercise can be done in the classroom or outside. Ask students to form a circle with their backs to one another, and their eyes focused outward, and straight ahead. In this arrangement, get students quiet. Then ask them to count how many sounds they hear in ten seconds. Afterwards, have students report how many sounds each one heard, and what they were. (*A word of advice:* Competition may set in, making it impossible to truly assess what was heard or how many things. If the leader begins by saying that he or she heard three things, this will give the students a reality check on how much they really heard.)

With students still in the circle, ask them to close their eyes and listen a second time for ten seconds. How many sounds did the group hear this time? Did they hear more with their eyes open, or with their eyes closed? Each time that this exercise is repeated, the students should note more sounds, and become more aware of their own level of noise-making.

Ask the class to consider what happens at Colorado National Monument when rabbits, squirrels, and birds hear new and loud noises in their environment? What can students do about their own noise levels as they head out on the trail? What can the group do to be able to discover more wildlife?

Developing Wildlife Viewing Skills

ACTIVITY PAGE

Quiet Walking

Prepare for this activity by paying attention to the types of clothing and shoes that your students are wearing. Choose a person wearing noisy shoes or clothes, or with a heavy gait, to go out of the room on a short errand for you, such as filling up a cup of water at the drinking fountain. (Clogs, work boots, heavy soled shoes, squeaky sneakers, loose pants that rub against one another, wind breakers, or stiff clothing that rustles are good choices for this activity.) When the helper has gone, tell the class to be very quiet and listen for his or her return. Ask them to raise their hands when they hear him or her coming down the hall. When the person arrives, explain the trick you pulled, and have students tell the person what they heard. Repeat this activity several times, and notice how sly the students become on their return from the "errand." The purpose of this activity is to heighten students' awareness of the level of noise that they make without being conscious of it.

For an additional experiment, ask the class to lie on their stomachs with their ears to the ground when the "helper" goes out on the "errand." Can they sense someone's approach from the vibrations in the floor around them? Snakes, which are deaf, rely on their bodies to sense tiny movements in the earth to that tell them when someone, or something, is approaching. As a result, they are more alert and sensitive to sounds within and around them. Discuss what the students noticed when they were lying on the ground. What have they learned about noise and vibrations that can be applied to their field trip?

Developing Wildlife Viewing Skills

ACTIVITY **PAGE**

I Spy

This is another useful activity to develop observation skills in advance of a field trip. Most students and teachers think they are familiar with their school "habitat" based on how much time they spend there. Yet they are quite surprised to see who else is living right along side them, yet overlooked. Send the class out to discover as many examples of "wildlife" as they can around the school building in fifteen minutes. This can include animals, birds, reptiles, amphibians, insects, spiders, crustaceans, and mollusks. Students must document their findings by recording the exact location of wildlife on a sheet of paper. Teams can be sent out to different areas, or everyone can concentrate in one room. Examples of findings are: ravens on the playing field; black widow spider in a web behind the teacher's bookcase; dead cricket under a computer terminal; domestic cat walking by the 6th grade window; centipede in the carpet by the principal's office. All ages enjoy the discovery process. Documentation and observation of behaviors can be made more complex for older age groups.

Animal Signs

ACTIVITY PAGE

Age Level

4th through 8th grades.

Purpose of the Activity

The purpose of this activity and its worksheets is three-fold.

1) To aid the student in identifying signs of wildlife, such as tracks and scat.
2) To introduce students to a structure for formally recording and comparing observations, like a wildlife biologist might use to make wildlife observations in the field.
3) To give teachers specific material for a small field notebook to aid in focusing, guiding, and documenting student discoveries on a field trip at Colorado National Monument.

Amount of Time Required

This activity is very flexible. Depending on the teacher's needs, it can last from thirty minutes to several hours.

Materials Needed

Each student needs:

- ☐ 1 copy of track worksheet.
- ☐ 1 copy of scat worksheet.
- ☐ 1 - 5 copies of wildlife observation sheet. (Number will vary with age and amount of time that will be spent on this activity.)

The teacher will need:

- ☐ Stapler to put worksheets together into a book form.
- ☐ Field guides to wildlife identification and tracking to supplement information provided.

Optional:

- ☐ Colored paper covers to make the worksheets into a more personalized notebook.
- ☐ Worksheets on plant identification from "Botanical Journal" or "Plant Scavenger Hunt" to add to the notebook for more complex and complete habitat investigations.
- ☐ Binoculars, cameras, and magnifiers.

Animal Signs

ACTIVITY PAGE

Best Location

Due to the flexibility of these worksheets, many different locations may be used. For one-half day for a field trip, use these "field guides" on trails near the Visitor Center, such as the Alcove Nature Trail, Canyon Rim, or Otto's Trail. Devils Kitchen and Old Gordon Trails are also good options on the East Side of the monument. For day-long outings, Black Ridge, Liberty Cap, and Monument Canyon Trails all have plentiful signs of wildlife.

Background Information

Visitors to national parks often assume that by coming to such a natural setting they will see wildlife. Many are disappointed that "nothing" was there. In fact, many kinds of wild animals, birds, reptiles, amphibians, insects and spiders make the canyons and mesas their homes, but they may not be visible right away. The visitor willing to take time, be aware of the surroundings, and move with a quiet step and voice, can be rewarded with close-up or extended views of a diversity of local inhabitants. In order to be successful in wildlife watching, students must learn to distinguish their behavior on the school grounds from that on a field trip. For activities to practice such behaviors prior to an outing, the teacher may want to try some of the exercises listed in "Developing Wildlife Viewing Skills."

Even though wildlife may not be on the trail, you may still encounter signs of many dramas that have unfolded. By traveling slowly, and taking time to investigate the details of the rocks, canyon walls, pinyon trees, and even in the depths of a bunch of grass, signs and stories of what has come before are awaiting discovery.

Perhaps a mule deer rubbed its growing antlers against the bark of a tree. With a closer inspection, you may spot a tiny scrap of the fur that came free…

Moments before you arrived, a desert cottontail rabbit hopped across the dusty path leaving a trail of perfectly etched front and back footprints. Where was it going? If you pause, look for movements trailside, and listen for rustlings in the bushes, you may be rewarded with a view of the rabbit nibbling on a rice grass stem…

Dangling from a tree branch is a bright blue feather that catches your eye. Below it is a pile of empty pinyon cones. Together they mark the molt and the meal of a pinyon jay…

What looks like white paint splashed on the canyon wall is actually the feces of a raven that perches at that place every day to warm itself in the early morning light…

Animal Signs

ACTIVITY
PAGE

A second glance at a small heap on a rock reveals a pile of kit fox dung. In it is the story of a race for a burrow, and the fur and bony remains of a kangaroo rat that was not quite fast enough to escape the fox…

Amongst the dirt and pebble debris atop a harvester ant nest rests a bright colored rock. A closer look shows the rock to be a chip from an arrow point of a long ago people.

Thus, as wildlife goes about its daily (or nightly) activity, it leaves behind many such signs and stories for the attentive watcher.

While close-up views of wildlife like those seen on television may elude many park visitors, given a relaxed pace, and attention to detail, many stories about area inhabitants may be revealed. Feathers, nests, bedding areas, diggings, chewings, burrows, and webs are clues as to what is nearby. The following pages include pictures and descriptions of animal tracks and scat (droppings) that might be seen in the monument. The sheets may be copied for use singly, or they may be organized into a small field notebook for students to take with them on the field trip. Each page offers identifications of specific tracks and scat, as well as space for students to record their own discoveries.

Animal Signs

ACTIVITY PAGE

How to Do the Activity

Before the trip

Copy off the "Track and Scat Identification Sheets" as well as the "Wildlife Observation Sheet". Depending on the length of the field trip, the age of the students, and how many other activities that you want to use, compile the sheets into a small "Field Guide to Colorado National Monument's Wildlife". The teacher may want to involve students in the compilation, decoration, and individualizing of the notebooks. If nature magazines are available to cut up, pictures of animals may be glued on to make the "Field Guides" very unique.

Classroom Discussion

In class, discuss the types of wildlife that students expect to find at Colorado National Monument. It is worth emphasizing the rodent, rabbit, lizard, bird, insect, and spider populations, as their sheer numbers make them more likely to be seen. For still more linkage to curriculum standards, you may want to expand the review to include food chains, and the diversity of them to be found in the area.

Develop Stories About Wildlife

Next, ask the class what all creatures need in order to survive. Food, water, shelter, space, community, procreation, and safety should all be covered. Then, investigate one animal in particular. How does it go about its daily life in order to meet those basic needs? As a group, develop a story about that creature and how it survives. For example: "As the sun rose, the desert cottontail could feel the warmth inside its burrow grow. It peeked out the hole, and looked around to be sure it was safe. Moments later, it hopped over to a bunch of grass and began eating. Scampering to the next patch of grass, it left footprints in the soft earth, and a trail of tiny, round, brown droppings. When the shadow of a golden eagle passed over the area, the small rabbit froze in fear. The eagle sailed on, and did not see it camouflaged against the bush. The little cottontail was safe—for now." If possible, write the story down on the chalkboard or a piece of paper for future reference.

Ask the students what signs of life the cottontail might leave behind. Make a list of them on the chalkboard. Refer to the story, and see how it gives information about the signs the cottontail left behind: a burrow (shelter), tracks, droppings, and chewed off grass blades. Even if you never see the cottontail, the signs of its activities tell the story of its life.

Lastly, divide the class into teams, and repeat this activity, with each team developing a short story about some wild creature and the signs it leaves behind. If time runs short, this can become a homework assignment.

Animal Signs

ACTIVITY PAGE

Step-by-Step Instructions for the Field Trip

At the start of the hike, pass out the "Field Guides" made previously in class. Review with students some of the "Tips for Spotting Wildlife", and establish rules for the class to follow for both safety of the wildlife and for themselves. Reminders that students should NOT pick up lizards (many bite), dig up burrows (things in them bite), or reach up onto ledges with their hands where they cannot see (snakes bite too), are important.

If students fill out the "Wildlife Observation Sheets" as they go, the group is likely to become too spread out along the trail. A better option is to choose several places that the teacher has scouted previously in which to concentrate the search. Working singly or in teams, students look for signs of wildlife throughout a large area. If they find droppings of a deer or rabbit, encourage them to look nearby for signs of the animals' chewing on leaves or grass. If fox or coyote scat is discovered, have them look closely to see if they can determine what the animal ate (berries, beetles, mice, etc.)

When a track or scat is found that cannot be identified with the sheets, ask students to draw AND write a description of it. This is the note-taking method used by wildlife biologists when they are in the field.

A similar approach can be used about wildlife observations. Once a creature is spotted, ask students to watch its actions and try to remember as many details about it as possible. Later, the "Wildlife Observation Sheet" can be filled out with information gathered.

With more than one of these sheets included in the notebook, several observations can be made. If an uncommon animal, one exhibiting curious behavior, or one traveling in an unusual place is seen, the wildlife observations of the students can be very useful and important to National Park Service staff. Your class may want to call the rangers with the report, or forward copies of the observation sheets to them.

Animal Signs

ACTIVITY PAGE

Extensions

This activity may be expanded in the classroom in the following ways.

~ Technical writing. Students research a specific bird, animal, reptile, amphibian, spider, or insect living at Colorado National Monument. These may be ones seen on the field trip — or not, at the teacher's discretion. Research is undertaken using a variety of sources, from field guides, to natural history narratives, to newspaper articles, to scientific journals available at Mesa State College or the public library, to the Internet. In some cases, interviews of wildlife officials may be most informative. When research is complete, a short paper is written using the structures and styles of a scientific journal.

~ Classroom discussion. Students discuss how the skills of wildlife observation and identification of tracks and scat would be used by earlier cultures. For example, how would "reading the land" help a settler in the Grand Junction or Fruita areas to choose a home site? How would such skills assist a Ute hunter to provide for his family? How do such skills benefit modern people? Can such skills be used to determine about population changes, impacts of pollution, weather, or even fire?

~ Create a food web. Students work as teams to incorporate the information that they learned in the field with projections they make in the classroom. They design a food chain using the signs, tracks, and other observations that they made at the Colorado National Monument. For example, if a student observed a yellow-headed collared lizard on a rock, what kind of food would it need to survive? What do those creatures need to survive in turn? And those creatures? The cycle spirals down until the most basic elements needed by plants are reached, including sun, water, and soil. The food chain may also be extended upwards. What would eat the lizard? What would eat that predator, and so on, until either human beings or nothing else eats that creature is reached. This web can be represented graphically or in words on a piece of paper.

Animal Signs

ACTIVITY PAGE

~ Even though you do not see wildlife on the trail, you may still encounter signs of many dramas that have unfolded. If you slow down, and take the time to investigate the details of the rocks, canyon walls, pinyon trees, and even in the depths of a bunch of grass, you will discover signs and stories of what has come before. Perhaps a mule deer rubbed its growing antlers against the bark of a tree. With a closer inspection, you find a tiny scrap of the fur that came free. A cottontail rabbit hopped across the dusty path, creating a trail of perfectly etched front and back feet. Where was it going? Dangling from a tree branch is a bright blue feather. Below it is a pile of empty pinyon cones. Together they mark the molt and the meal of a pinyon jay. What looks like white paint splashed on the canyon wall is actually the feces of a raven that perches at that spot every day to warm itself in the early morning light. A second glance at a small heap of sticks atop a rock reveals a pile of kit fox dung. In it is the story of a race for a burrow, and the fur and bony remains of a kangaroo rat that was not quite fast enough to escape the fox. Amongst the dirt and pebble debris atop a harvester ant colony rests a bright colored rock. A closer look shows the rock to be a chip from an arrow point of a long ago people.

The following pages are pictures and descriptions of animal signs you might see in the Colorado National Monument. They may be copied or organized with the "Wildlife Observation Sheet" into a small field guide for students to take with them on the field trip. The sheets will provide students with identifications of tracks and scat, and space to record any discoveries of their own.

Animal Signs

ACTIVITIES FOR STUDENTS

Scats

	Mule Deer	Looks like small brown rocks or pebbles. May be clustered or scattered over a distance. Shape is blunt oval, about the size of a thumbnail, in some seasons. Other times scat resembles a stack of small pancakes one atop the other.
	Desert Bighorn Sheep	Resembles deer droppings, only larger. In shape, they may look like acorns, round at one end, and pointed at the other. May be clustered or scattered over a distance. Found on ledges and talus slopes, occasionally near pools of water.
	Desert Cottontail	About the size of a hole punched in a sheet of notebook paper, these small, ball-shaped droppings are brown-green when fresh. When dry, they are white, and look like pebbles. Very common by clumps of grass and under trees.
	Coyote	Although it looks like dog feces in size and length, inspection will show coyote scat contains animal hairs, bones, seeds, insect parts, even trash. In contrast, dog scat has no hair, is uniform in texture, and is the same color as dry dog food.
	Gray Fox and Kit Fox	Scat is smaller than coyote's, about the size of a human finger. Rodent or rabbit hair, bones, seeds, insect carcasses are commonly found in it. Segments are drawn out to long points with twisted hairs connecting them. Seen on trail or rocks.
	Bird Droppings	Bird droppings are a liquid mixture of white urine and dark feces. In places where birds perch, feed, or nest on rocks or cliffs, large patches of droppings develop. This "whitewash" can be a indicator of where to find eagles, ravens, or hawks.
Draw a scat you found.	**Can you identify who made it?**	**How would you describe it?**

Animal Signs

ACTIVITIES FOR STUDENTS

Tracks

	Desert Cottontail	Four footprints visible at once. Front feet make small circles. Hind tracks show feet and part of lower leg, making long, oval tracks. Larger hind feet usually land in front of smaller front feet. Occasionally claws visible. No pads seen. Found in scrub areas. Tracks do not go far from burrow.
	Coyote	Prints look like a dog's, with 2-4 claws visible. Four toe pads form a close semi-circle around a larger triangular main pad. Front foot is larger than hind foot. Tracks may be in a straight line; front and back feet alternate when walking. Front and back feet come down together when trotting.
	Mountain Lion	While pads may look similar to coyote, claws do not show up. Front foot larger than hind. Toes widespread, especially if running. Track is usually wider than long, as compared to a coyote track, which is longer than wide.
	Lizard	Lizards make tracks that are quite distinct. They are often found in the dust along trails or near rocks where lizards make their homes. Between four small, long-toed footprints that point outward is a long thin line created by the tail dragging along behind.
	Common Raven	Track is three-toed, talons often visible. Size varies from 1 to 1 1/2 inches in length. Toes spread out but are all forward pointing, like holding up three middle fingers as you count. Impressions of the foot joints and the ankle bone may also be found. Tracks wander around, then vanish.
Draw a track that you see.	**Can you identify it?**	**Describe what it looks like.**

Lizard Patrol

ACTIVITY **PAGE**

Age Level

4th through 8th grades — and up.

Purpose of the Activity

The purpose of this activity is to create a structure for observing and reflecting about wildlife. For many students, their contact with animals is a cat, dog, or goldfish at home. Without experience in a natural setting, they do not know how to go about looking for, or looking at, wildlife. While this activity cannot guarantee that the class will find any wildlife, it will certainly spark an awareness of what could be out there. Secondarily, skills related to reading, writing, note-taking, analyzing, and synthesizing are all utilized.

Amount of Time Needed

30 minutes in the classroom for Part One. 30 to 60 minutes in the field for Part Two. 30 to 60 minutes for Part Three.

Best Location

Part One and Part Three should take place in the classroom. For Part Two, the wildlife watching, any trail in Colorado National Monument may be used. The group will have more success on trails that are not heavily traveled by other park visitors. If lizards are sought specifically, then Monument Canyon Trail (lower or upper); Devils Kitchen Trail; Otto's Trail; Alcove Nature Trail; and Canyon Rim Trail will give the most sightings. Older groups may want to use the east side of Devils Kitchen area, where three developed trails come together: Devils Kitchen, Old Gordon, and No Thoroughfare Canyon.

Materials Needed

For Part One:

- ☐ Books and poetry by nature writers.

For Part Two – The Field Trip:

- ☐ Blank paper, clip boards, and pencils are all that is needed for this activity. Binoculars are a real asset for spotting animals at a distance, but are optional.

For Part Three:

- ☐ Blank paper, colored pencils, markers, pencils.

Lizard Patrol

ACTIVITY PAGE

Background Information

Not so long ago, watching wildlife was a matter of necessity. Animals represented food on the table, warm clothes in the winter, and danger in the form of predators. The lives of humans were intertwined with those of the birds and animals nearby. Today, wildlife watching is a matter of recreation. Separated from the need to hunt, our connection to the land has changed. We visit parks and open space for enjoyment and relaxation; then we leave them behind.

As we have grown separate from the land, our knowledge, comfort, and vision of it have diminished. Wild places now represent the unknown, and feel foreign to many people. Such distance makes it difficult to care about what happens to the land, and its inhabitants. Rather than seeing our common ground with wildlife, we end up feeling scared or threatened by how unfamiliar it is. We squash spiders, fear snake bites, and worry about attacks by "wild" animals. Thus, our modern lifestyle has come to hinder our ability to "see" and experience the natural world around us.

The terms "seeing" and "observing" often have a passive connotation, that an individual is sitting back and not "doing" anything. The dictionary defines "seeing" in a different light. To "see" is to: "a) perceive with the eye; b) to have an experience of; c) to come to know—discover." "Observing" involves "sensing with careful, analytic attention." Under these definitions, "seeing" and "observing" become vital, active skills of value in a variety of situations including the classroom and the field trip. These interpretations of "seeing" and "observing" are at the core of this activity. Yet, instead of the classroom being the center of learning, the tables are turned, and nature becomes the instructor with whom discoveries are made.

The ability to "see" does not always happen quickly. More, it is a skill that is developed over time. Beginner's luck at discovering things certainly exists. However, the ability to read the landscape, to tell what happens there and who lives there, requires an attitude of openness, and awareness that may take a lifetime to achieve. "Lizard Patrol" is a beginning step on that path.

This three-part activity is intended to help make a connection between children and wildlife. In the first segment, students read about nature, wilderness, the opening of a flower, the beauty of a bird's flight, through the words of a variety of nature writers. With the perspectives of wordsmiths as inspiration, the students undertake the second segment of the activity: exploring a part of Colorado National Monument looking for lizards and wildlife. Moving slowly in small groups, they look for evidence of animals' passage. Settled in one place for fifteen minutes, they observe and record what happens around them. In this safe structure and quiet time, students have an opportunity to learn from nature and its many inhabitants. On returning to the classroom for Part Three, students write poems, short stories, or essays of their own, inspired by their experiences.

Lizard Patrol

ACTIVITY PAGE

This activity is titled, "Lizard Patrol" because Colorado National Monument is fortunate to have terrain that is much appreciated by lizards. Certainly a diversity of other bird, mammal, and insect life also thrives in the canyons and mesa tops, but lizards stand out for their abundance. Because of the quantity and diversity of lizards, and because their times of activity coordinate well with the hours of a field trip, lizards are among the easiest wildlife to be found in the park. Even though they are the focus of this activity, sightings cannot be guaranteed. Clouds, cool temperatures, rain, or the opposite, too much heat, can reduce their visibility. For more information about lizards specifically, see p. 131 in the background information for teachers.

Before going out on the field trip, introduce the class to the nature writings and poetry of a wide range of authors. Suggested writings include those of Henry Beston, Sigurd Olson, John Muir, Wendell Berry, Rachel Carson, Robert Bly, Annie Dillard, Aldo Leopold, Henry David Thoreau, Basho, Terry Tempest Williams, Gary Nablam, Barry Lopez, David Quamman and a multitude of others. No doubt the instructor will have some favorite authors and passages to share as well.

Each of the writers listed above spent time in nature as an observer. In their explorations, they discovered a joy and a humility at their place in the universe. Their reverence for the complexity, magic, and beauty of life is expressed in their language. Take advantage of the inspiration that these writers offer to the class. As students read about the intimacy and caring that these people felt about their subjects, and the land, the stage is set for the field trip, and making records of the experiences of the class in nature.

A curriculum note: Using such works, together with your class doing their own nature observing and writing, meets a number of different educational content standards for students in the areas of reading, writing, and science.

Before the field trip, gather a variety of writings about nature from different authors. Try to find enough so that each student may have their own book. The local library, fellow teachers, and parents are excellent resources for supplying you with material. There is a remarkable wealth of diverse nature writing available. An essay from *A Sand County Almanac*, by Aldo Leopold, is highly recommended for students in 6th grade and higher.

Invite some parents or friends to join you on this field trip as adult leaders. Their involvement will enable the group to be divided into smaller units for better success in finding wildlife. Groups of four or five students with an adult will also have an easier time writing and reflecting. The quiet, alone time can be more easily managed, and comfort maintained. However, if other adult leaders are not available, this activity can still be done as a large group.

Lizard Patrol

ACTIVITY PAGE

It is very useful for the teacher to preview the trail(s) that the class will use in order to find spots where wildlife has been active. Look for signs, tracks, and trails creatures may have left. Scat, fur, burrows, chewed leaves, scrapes, diggings, flattened grass are all indications of animal use of an area. Seek out mixed habitats, such as places where drainages and sagebrush flats meet, cliffs and talus slopes abut, rock formations change, or slickrock and pinyon-juniper groves come together. These interfaces of environments, called **ecotones**, are rich environments for wildlife of all kinds to find food and shelter. They are also places where students may have more success at finding wildlife, or signs of wildlife.

You may also want to contact Colorado National Monument staff at the Visitor Center front desk to find out about any unique or interesting wildlife sightings that have been recently reported. Peregrine falcons, for example, have been known to nest within the monument during the spring and summer. They, or desert bighorn sheep, could make for some very exciting wildlife watching for the class.

Another option that you may want to consider using is the Devils Kitchen Area. Not only are yellow-headed collared lizards and many other lizard species found there, but three developed trails come together in an ideal configuration for this activity. Small groups can each take their own trail, be it Devils Kitchen, Old Gordon, No Thoroughfare Canyon. If it is not busy, even Serpents Trail can be used. This arrangement allows students to be relatively close to one another, yet still far enough apart that no one has to be in sight of another. This area is also easy for reconvening to share observations. Parking is available at either the Devils Kitchen/ Serpents Trail Trailhead (cars) or at the Devils Kitchen Picnic Area (cars and buses).

Lizard Patrol

ACTIVITY PAGE

How to Do the Activity

Part One: Before the Field Trip

This part of the activity may take place one day to a week before the field trip. The closer the two parts are to one another, the more influence and connection there will be between them.

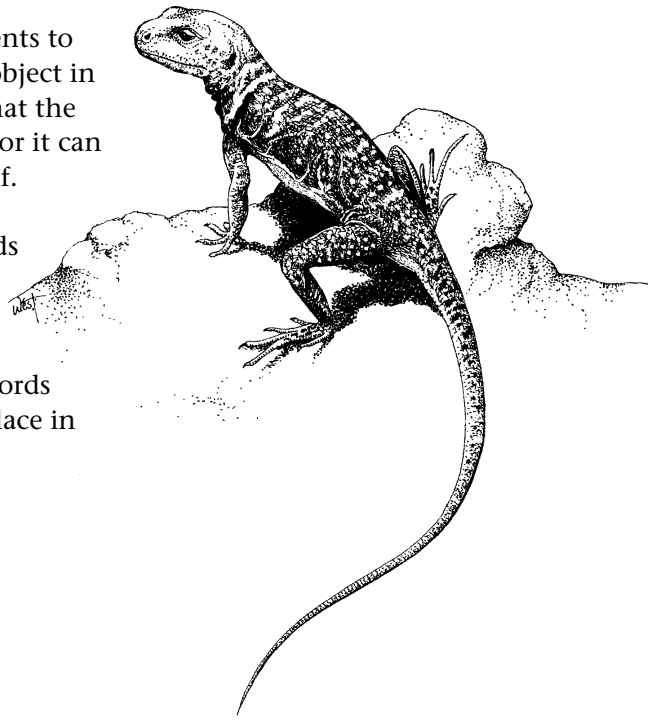
Choose A Nature Writing To Read

Invite students to look through a collection of nature writing that you have gathered. Each person should look through a book of their own choosing to locate a poem, passage, or image that they especially like. The teacher may want to begin by reading aloud several pieces that she or he enjoys by different authors. A humorous poem or anecdote works well as a starting off point.

Give students fifteen minutes to settle upon the writing that most appeals to them. Ask if anyone would like to share their finding. Encourage students to notice the different subjects, words, structures, and styles that the writers chose. If no one wants to share their piece, the teacher may ask each person to copy down their passage for future reference, or to mark it and turn it in so that it can be read aloud by the teacher. An important feature to highlight from each passage is how the author took time to observe and reflect upon their subject. Just as a painter must be well acquainted with the object being painted, so must the writer. Careful looking brings one closer to one's subject.

Observe An Object - Record Your Impressions

After the readings are complete, ask students to take a few moments to see and observe an object in the classroom. This can be a single object that the teacher brings in especially for this project, or it can be something familiar within the room itself. Students then suggest words or phrases to describe what they "see". The teacher records the words on the chalkboard, and students write them down in a notebook. Each student then composes one or more sentences about the object, and incorporates words listed on the board. The writing may take place in the classroom, or be done as homework.



Lizard Patrol

ACTIVITY PAGE

For example, students look at a skull on the teacher's desk. They describe it using the words: "old", "dead", "sharp teeth", "full of holes", "looks like a tiny dinosaur." These words are recorded on the chalkboard and in their notebooks. Students then formulate a sentence(s) about the skull that describes their observations of it, and incorporates any of the words that the class used.

Thus, Part One of "Lizard Patrol" helps students both to learn how other writers view the world around them, and to practice their observation and writing skills. Part Two expands the observation effort as the class looks for wildlife at Colorado National Monument.

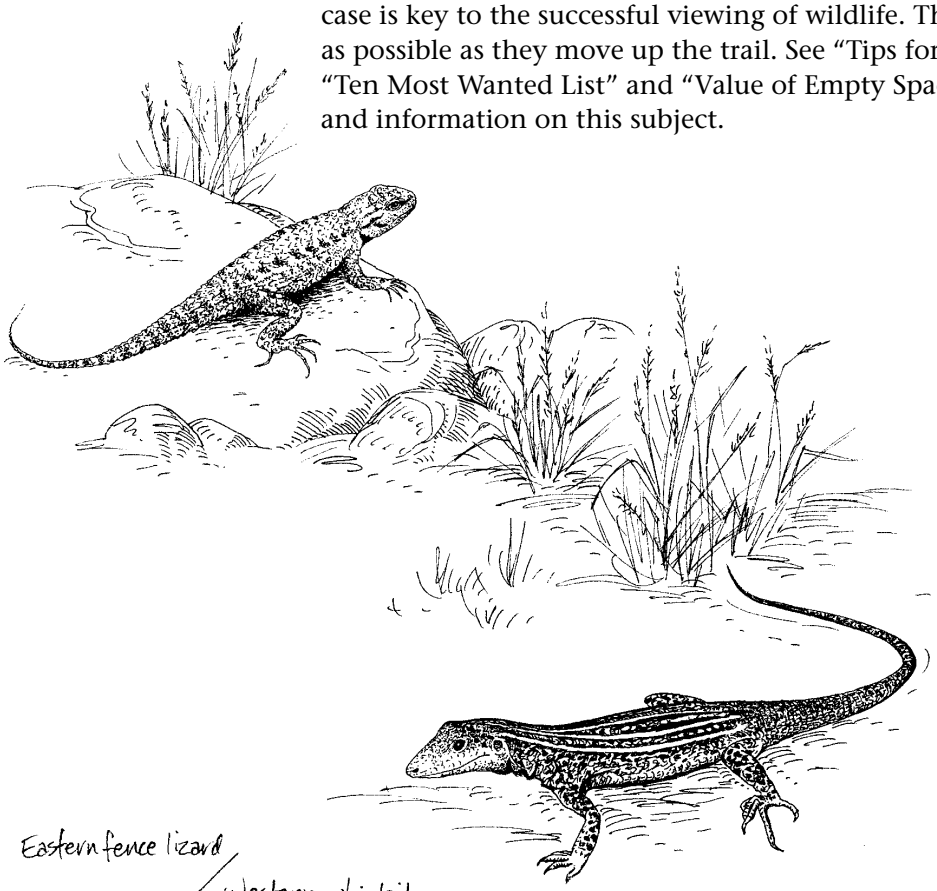
Part Two: At Colorado National Monument

Dividing Up The Group

Before heading out along a trail, divide the class up into small groups of 8 or fewer students. Each group should have an assigned chaperone. One adult per four to five children is ideal.

Because a large group makes enough noise to scare away wildlife, smaller groups are more viable. In addition, the more that groups spread out on the trail, the more frightening to wildlife they are.

While it is not natural for groups to stick together on a field trip, doing so in this case is key to the successful viewing of wildlife. The groups should also keep as quiet as possible as they move up the trail. See "Tips for Wildlife Viewing", "Stalking", "Ten Most Wanted List" and "Value of Empty Space" in this chapter for more ideas and information on this subject.



Eastern fence lizard / Western whiptail

Lizard Patrol

ACTIVITY PAGE

The Importance of Quiet on the Trail

The leader must be very clear about the need for quiet. If people are noisy along the trail, little wildlife will be seen. Hand signals are a useful means of communication. Agree upon some signals that everyone will use and recognize when they see an animal, lizard, or bird. If a group is normally noisy, try betting them they cannot be silent for a certain amount of time. Students enjoy proving the teacher wrong, and everyone will benefit by the quiet.

If the group is divided up, each small group should head down a different path in silence for a long enough distance that they are out of hearing range of the others. If the group stays as a whole, walk a distance down the trail before pausing to look and listen for what is ahead. All groups should go slowly enough that they can spot signs of wildlife, such as scat, diggings, nests, burrows, feathers, tracks, webs, etc. Assigning individual students to count and remember the different signs of wildlife that the group finds will heighten students' awareness of the patterns of activity and life around them.

Practicing Observation Skills

Practice observation skills on a bird. Gather the group in close when a bird appears on a nearby tree. Quietly watch what it is doing. Instruct the students to make mental notes about its color, shape, unique features, actions, location, etc. After the bird has flown on, ask the group what they saw. Try to elicit an observation from each person. Discuss when differences occur. What does the group think are the most important things to look for?

Summarize what was seen and explain that shortly the group will be making more observations about wildlife that they see. Many times, animal activities and behavior are of great interest to wildlife biologists. From their observations, they gain insight into the condition of the creature, as well as the health of the surrounding land.

After walking further along the trail, pick a place where students can spread out safely either on the path, or in an area nearby. Survey the chosen area for any potential hazards, such as cactus, glass, cliffs, or loose rocks. Avoid areas with black, lumpy cryptobiotic soil crust. It is easily destroyed if people walk or sit on it.

Lizard Patrol

ACTIVITY PAGE

Once a site has been chosen, explain to the group that they will be staying in that spot for fifteen minutes, and are to find as many types of wildlife as they can during that time. Once they get settled, they must stay put, and cannot move around. No one is to speak. They are to use their eyes and ears to look and listen around them. If an insect, spider, lizard, snake, bird, or animal comes by them, watch what it does. How does it look? Try to notice tiny details like the toes, or antennae, or wing patterns. Encourage them to think of themselves as a sponges, soaking up and storing as much information about the creature as they possibly can. And if nothing comes by, then watch the patterns of light and shadow; feel the wind, heat, or cold; study a rock, its shape and colors; look at the bark of a tree; observe the clouds moving by; investigate and really "see" some object or place nearby.

Observing All Around You

The object of this exercise is to see and observe what is around you, no matter how big or small. Even the tiniest pebble or ant has a story to tell, or is part of a larger drama that is still unfolding. Only if we take the time to look, and have an attitude of openness to observing what is there, do we get to know about the world around us.

Recording What You Saw

After fifteen minutes, ask the students to get out their pencils and paper and make a record of what they saw. They can draw or write, or both. They do not have to make complete sentences, simply write down words or phrases that describe what they observed. Give the group ten (or more) minutes to complete their recording. Be available to help anyone with problems or questions. Spelling and being correct are not as important as making an extensive a record as they can in their "field notes". More time can be spent doing this in the classroom if need be.

When the students finish the documentation of their observations, Part Two of the exercise is complete. Depending on the length of the field trip, and on how well the group handled this exercise, it can be repeated again (often more successfully) later in the day. Often the time after lunch or a snack, or after a break following a long hike, works well for a second try at this intense viewing.

Lizard Patrol

ACTIVITY PAGE

Part Three: In the Classroom

This final segment takes place in the classroom. Students use their "field notes" to create a short description (younger ages), or poem, haiku, short story, or narrative (older ages). Younger students should do the writing during class time, when the teacher is available to assist with questions or difficulties that come up. With older students, the teacher may choose to have students do the rough draft in the class, and the final at home, or vice versa.

First, students review their "field notes", and complete any that need to be finalized. Corrections of spelling or handwriting are not needed. The notes in their original form are valuable of themselves.

Organizing the Field Notes

Next, students organize the notes in an order that could be the "skeleton" into which the writing connects. For example, a student watched a bird, and made these notes:

> "Bird perch on tree…move its head all around…fly up and catch an insect in its mouth…too large for the bird to eat…legs hang out of mouth…flew away… yellow stomach…black eye."

In finalizing the notes, the student adds, "Blue sky day. Sun hot. Pinyon tree." The notes of themselves are jumbled, but together they create a feeling for the bird, the day, the episode. The final draft read as follows:

> "Hot sun fell on the pinyon pine.
> A yellow-bellied bird found it fine.
> It flew up to catch a meal.
> I wonder how eating an insect feels."

Describing What You Saw

Lastly, students use their notes to compose a piece of writing that describes what they saw. The format can be of their own choosing, or modeled after the writing of one of the authors in Part One. The emphasis can be scientific: describe what you saw. Or the writing may be more creative: describe a feeling, mood, or image from what you saw.

Conclusion

This three-part activity encourages the skills of "seeing" and "observing" wildlife, while also encouraging writing and language arts skills.

The writing of the class can be incorporated into a group book, arranged into a collage on a bulletin board, or formatted on a computer disk as part of a final draft. Artwork can be added into these writings as well.

Stalking

ACTIVITY PAGE

Age Level

4th through 8th grades. However, with modifications of distance, younger and older groups will also enjoy and learn from this exercise.

Purpose of the Activity

"Stalking" is an activity that simulates a predator-prey relationship in order to illustrate the degree of inter-connectedness between the predator and the prey. Through it, students come to appreciate the adaptations for survival of both predator and prey. Observation and listening skills are also enhanced through "stalking".

Amount of Time Required

15 to 30 minutes.

Materials Needed

None.

Best Location

An open space is needed so that predators (students) can see their prey (adult chaperone or teacher). A distance of 20 - 30 feet is recommended for the stalking area, but other spaces may also work. Trailheads or wide areas on slickrock will work. Remember to choose your location so that fragile cryptobiotic soil crusts will not be trampled. Alternatively, this activity may be done on a playing field at school.

Background Information

"Stalking" is an excellent warm-up to get a group working together and in high spirits. It is also effective as a "filler", where students have been concentrating on a subject, and now need to let off steam. Lastly, it is a useful concluding activity, since many themes can be integrated into it. Be aware that it can become boisterous, with the students enjoying the role reversal of themselves as predators, and the adult leader as their prey.

"Stalking" focuses on the predator-prey relationship of the mountain lion and the mule deer. While mountain lions are known to eat other animals, including rabbits, rodents, beavers, porcupines, and skunks, their dominant food source is deer. Contrary to what some people think, lions often cull the old, weak, sick, or injured members from a herd of deer. Wildlife researchers feel that this creates a positive connection between these two animals, as one gets food, while the overall health and strength of the deer population is maintained.

Stalking

ACTIVITY PAGE

A lion does not usually move quickly to a kill. It watches the herd, looking for a target, and then follows stealthily along getting closer and closer. This stalking may last for minutes to hours, as the lion avoids unnecessary noise and motion that might scare its quarry away. Going slowly also helps the lion to conserve its energy for a final burst of activity during the capture. Creeping nearer to its target, it waits for the right moment to spring up onto the back of the deer. Using its strong front paws and claws, it grabs the deer around the throat and quickly breaks the neck. Death is swift.

Afterwards, the lion may drag its prey to a safer location for feeding. When sated, it buries the carcass under leaves, dirt, or branches to save it for a later feeding. Then it may find a sheltered spot nearby to clean itself, rest, and digest.

For those students who are animal lovers, vegetarians, or animal rights advocates, the teacher may want to emphasize the difference between the "kill for the thrill" of a domestic cat, which, in many cases, has no need of the bird for food; and the "kill for survival" of the mountain lion. Discussions of what would happen if large predators were eliminated from nature are most appropriate in the context of this activity. On one hand, we say we love animals and wildlife. On the other, we are uncomfortable with what they may do to survive, and by how close to us they may be. Watching African lions and cheetahs hunt and kill on television is tolerable, but we do not want animals hunting in our own backyard! Where do these attitudes lead us? What can happen to the deer population — or any other — with no checks on its numbers? What effect would the deer have on the land if their numbers grew dramatically? Who and what else might be affected? Many valuable lessons and discussions are touched on by this simple, fun game.

Stalking

ACTIVITY PAGE

How to Do the Activity

Recruit an Assistant

Before you begin, discuss the "Stalking" activity with the chaperones for your group. Recruit one person to monitor the student "predators", and not let them get going too quickly. If a chaperone has a good sense of humor, and doesn't mind taking the limelight for a while, then you can appoint that person as the "DEER" (prey), and you can be the monitor. This is something that the teacher will have to gauge for himself or herself. Is it better for you to monitor, or better for the students to have the thrill of hunting you?

Step-by-Step Instructions

1 Introduce the activity by asking students to list as many predator-prey relationships as they can. Encourage them to think of global as well as local connections. Classic examples include:

~ lions and impalas;

~ snakes and mice;

~ grizzly bears and salmon;

~ golden eagles and rabbits;

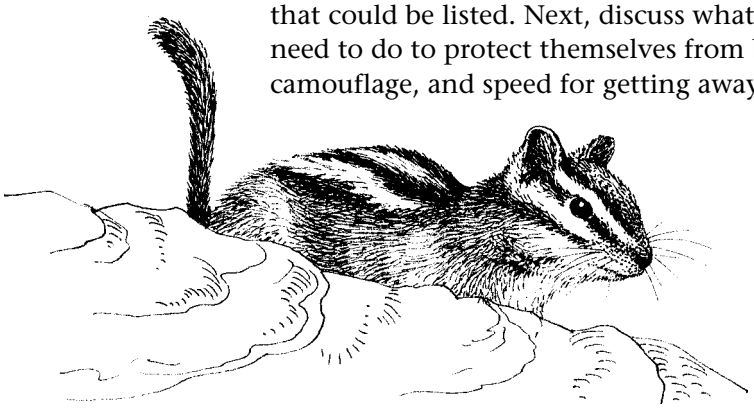
~ domestic cats and birds.

The latter is a predator-prey relationship of complex and emotional proportions. See Extensions for more about cats and birds that involves deductive reasoning as well as math skills.

2 Carefully choose the location for this game, and be sure to establish some boundaries. Students like to spread out, and in no time someone can wander off.

Discuss Predator-Prey Relationships

3 Explain how the game is played by asking how predators catch their food. What are the most important skills for a predator to have to catch their prey? Surprise, stealth, patience, persistence, skill, speed, strength are among the qualities that could be listed. Next, discuss what prey, such as rodents, birds, and insects, need to do to protect themselves from being eaten. Good eyesight and hearing, camouflage, and speed for getting away are all useful.



Stalking

ACTIVITY PAGE

4 Review what was learned in warm-up exercises such as "Quiet Voices" or "The Ears Have It". (Both of these are described in the "Developing Wildlife Viewing Skills" activity earlier in this chapter.)

How "Stalking" Works

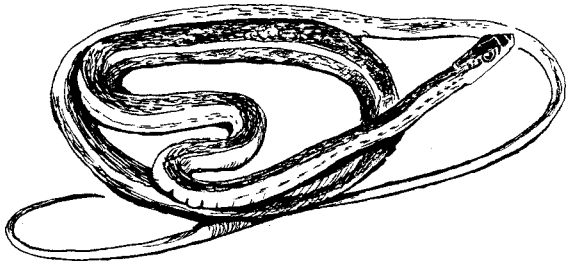
5 With this background, explain how "Stalking" works. The students will be the "predators" — mountain lions — which are hunting for food. They must sneak up on their "prey" — a mule deer — in order to catch it for food. (The mule deer, incidentally, happens to be the teacher.) At this point the rules of the game must be given, or the students will be so eager to test their predatory skills that they will not listen, and a melee will result. It may anyway, but that, too, is a lesson.

The Rules

- The object of this activity is to sneak up on the "prey" and catch it, without being caught yourself.
- Whoever gets to the "prey" first, without being heard or seen, is the winner. (This is harder than it looks, because the mule deer has excellent hearing, and is always alert for danger, even when feeding. The mule deer also has good vision, and is sensitive to the slightest unexpected movement in the habitat around it.)
- "Predators" should be as quiet as possible, and watch where and how they step.
- If the "prey" hears a "predator", it will quickly turn around and point in the direction of the sound. Whoever is closest to that place is caught, and is immediately out of the game. No arguments allowed.
- The monitor will tell the predators when to start, and will have the final say in resolving any disputes about someone being heard or seen. The monitor will move along with the group to keep track of things.

6 Appoint the students as "predators" (mountain lions) from here on. They will love this idea, and may take some calming before proceeding. They must all get behind an imaginary line, and the game cannot begin until everyone is there. Designate the monitor in charge of the game. Lastly, introduce the "prey" (mule deer) who can be either the teacher or a chaperone.

7 The "prey" should walk about 25 to 30 feet away from the group. When it turns its back and pretends to eat grass is the signal for the "predators" to begin sneaking up on it. If, however, the deer hears the slightest sound, it will turn around and point to where the sound was coming from. The "predator"/student standing nearest to that point is caught, and is automatically out of the game. When the deer turns around, everyone else must freeze in place. After the "predator" who was caught moves out of the area, the game resumes: the "prey" goes back to eating grass with its back turned, and the "predators" begin sneaking up again. It is repeated over and over until all "predators" are out, or until the "prey" is tagged by one of the mountain lions.



Stalking

8 The monitor's role is to start the game, and once it is proceeding, to keep watch on the "predators" so that they stay within the boundaries. If disputes arise about who really made a noise, the monitor has the final say. Lastly, the monitor must remind the "predators" that have been caught to remain quiet so that the rest of the game can be completed.

9 No outcome to this game can be predicted. Sometimes, many students get caught in the first few steps. After that, the remaining bunch gets sneakier. Ironically, those who are most shy in the group have the advantage, as they are slower to move, and therefore less noisy! More than once, the most timid person has turned out to be the finest predator, as she/he uses the most caution and patience. Naturally, there will be a few who burst forth to try to catch their "prey" with speed. They may or may not be successful. You can discuss these different strategies after the game.

Conclusion

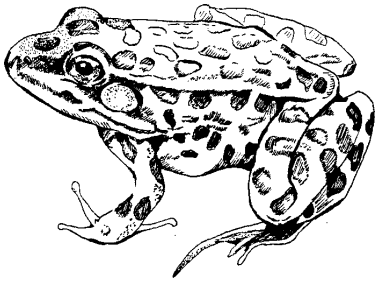
Everyone, young and old, adult and child, will have great fun with the "stalking" activity, and want to continue doing it over and over. Students really do learn valuable lessons about predators, prey, and the interconnectedness of wild animals at the same time as they have fun.

Extensions

This game works well for all ages, from kindergarten on up. With younger students, use less distance between predator and prey, and let them have fun playing this unique version of red light-green light. With older groups, more complex lessons from school curricula or from the other extensions can be integrated with the "stalking". The discussion about predators and prey could be a lesson in the classroom before or after the field trip. No matter what the age, sneaking up on something in the grass, or across rock is challenging and fun.

Wildlife videos

Wildlife videos, including presentations from NOVA, the National Audubon Society, and others can complement this activity well.



Stalking

ACTIVITY PAGE

Researching predator-prey relationships

Students work in teams or as individuals to research and write a report on a predator-prey relationship that interests them. Information to cover are methods that predators use to capture prey, and strategies that prey have to avoid being captured. Adaptations of predators to local food and environmental conditions could also be included. For example, coyotes, foxes, raccoons, skunks, and deer all have come to live on the fringes of human communities, because they have come to eat our leavings (garbage), our crops (alfalfa, corn, orchard fruit), even our gardens.

Literature and media review of predator-prey relationships

Teams of students develop a list of predator-prey relationships that can be found in literature, comic books, movies, videos, Nintendo, television, and other cultural materials. Research can be done by going through the card catalog at the school library; visiting a video store; going through the television channel guide. Examples of classic relationships can be found in the works of Beatrice Potter and Rudyard Kipling, the Disney movie, "The Fox and the Hound", and even the cartoon "Garfield". Students report these back to the class several days later.

Domestic cats and birds: A mathematical and environmental puzzle

Domestic cats and wild birds are a predator-prey relationship that is familiar to many people. In this activity, students use the mathematical skills of computation, estimation, and data analysis to assess the impact of domestic cats on the wild bird population.

1 Begin by finding out who has a domestic cat at home. List that number of cats on the chalkboard. Ask the number of students in the class, and place that number below the number of cats on the board. Make these two numbers into a fraction. This becomes the "rate of cats".

2 Next, find out from the cat owners the number of cats that like to catch birds. Get an estimate of how many birds are caught in a day. Record these numbers on the board. Ask students to compute the number of birds caught in a year if the cats catch them at a steady rate of ___ / day. This becomes the "capture rate".

3 If 110,000 people live in Mesa County, how many of them own cats? Use the "rate of cats" (from #1) to project the number of cats in the county. If the cats in Mesa County capture birds at the same rate as those in the classroom, how many wild birds are killed by cats each year in the county? If that figure seems high, you may want to adjust it by figuring that 15% of the cats in the county do not go outside, and 10% more are too old or too slow to catch birds. What, then, is 75% of the original estimation? If the remainder of those cats each capture one bird per day, how many birds per year is that? If there are 10 million cats nationwide, and they, too, catch a bird a day, how many wild birds per year are lost?

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While this figure may seem inflated, remember that no one really has an accurate count of the cat population. Conservative estimates are 50 - 60 million cats, and that figure is from 1991![1] Neither is there an accurate estimate of the number of feral cats, those that live outdoors but may have minimal human contact, or those born in the wild. Imagine the impact that these predators have on small rodents, birds, reptiles and amphibians!

Figures like these have been a wake-up call to many bird lovers and bird researchers. What is the best way to handle the conflict between our long-time love affair with cats, and our rapidly growing hobby of attracting birds to our backyards? Rich Stallcup, an avid bird-watcher and preeminent bird researcher in California, has written numerous articles in recent years on this subject. He calls the impact of domestic cats on the bird population a "reversible *cat*astrophe".[2] Among his suggestions of what to do to help save wild birds from cats are:

~ Proclaim your yard a refuge for birds. Plant it for wildlife, and defend it against interloping cats.

~ Reduce your cat's ability to catch birds by keeping it in the house as much as possible. If your cat goes outside, attach bells (more than one is necessary) to its collar to help birds hear the cat as it approaches.

~ Discourage your cat from hunting wildlife by squirting it with water when it even thinks about stalking birds. It will still love you.[3]

[1] Stallcup, Richard "A Reversible Catastrophe: Cats Take a Heavy Toll". The Observer. Quarterly Newsletter of the Point Reyes Bird Observatory . Stinson Beach, California. Spring- Summer, 1991. p. 8 - 11.

[2] Ibid p. 10.

[3] Ibid p. 11.

Who Lives Here?

ACTIVITY **PAGE**

Age Level

4th through 8th grades.

Purpose of the Activity

To improve observation skills, and to increase appreciation for the many signs of wildlife that can be found in nature.

Amount of Time Required

45 minutes to 2 hours. This activity is especially effective if used as one element on an all-day hike.

Materials Needed

- ☐ Sticks — 5 for each child. (Bamboo skewers work well, and are available in most grocery stores,.)
- ☐ Bright yarn or survey tape — 5 inch strips are needed to tie onto each stick so they look like small flags.
- ☐ Markers — for making designs on the sticks to aid in recognizing them.
- ☐ Rubber bands or string — to hold flags together.
- ☐ Optional: Big piece of paper and markers for recording findings.

Best Location for Activity

Lower Monument Canyon, Upper Liberty Cap, or Black Ridge Trails are good places for this activity. Since the leader needs to see all that is going on, an open area with clear boundaries that are easily recognized is important. The site should have a variety of trees, shrubs, grass, and rocks to make it interesting for the students. Along a drainage or where two habitats meet, can be ideal places for this activity. Choose sites carefully, and do not send children into areas with cryptobiotic soil crust.

Who Lives Here?

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Background Information

Children can find amazing things when they slow down and really look. "Who Lives Here?" gives students a controlled freedom that can result in marvelous discoveries. Later, when they share with the group what they encountered, students feel a sense of satisfaction and pride. The leader's interest and enthusiasm about the finds encourages students to seek still more. Often these small finds set the stage for great observations and wildlife sightings later on.

Since the focus of this activity is discovery, an expertise in wildlife and plant identification is not required. While it is helpful to recognize that a cone-shaped hill of soil and pebbles is an ant hill, knowledge of ant biology is not necessary at this level. It is more important to spot tracks, scat, feathers, nests, and burrows than it is to know to whom they belong. Many field guides to wildlife identification are readily available, and can be brought along if desired. The "Wildlife Biographies" in Background Information for Teachers, and "Animal Signs and Stories" handouts in the Activities section may also be helpful to review.

Who Lives Here?

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How to Do the Activity

Step-by-Step Instructions

Preparations

1 Be sure to preview the trail and area where you will be conducting the activity. Exploring on your own beforehand will give you ideas and information on what is living in the area. Take time to plan out the sites for the students to explore. You will need one area for every two children. It may be helpful for you to make a written record or map of the locations that you choose.

2 Take time in the classroom to:

~ Discuss the type of environment you will visit, and the kinds of wildlife that you might see there. List them on the board. Remember the smaller creatures, such as rodents, birds, spiders and insects. The point of this activity is to encourage students to discover the **multiplicity** of things that are around them, not just the most exciting wildlife.

~ Brainstorm different signs that wildlife might leave behind. Tracks, fur, scat, nests, webs, feathers, dens, burrows, scratchings, bones, chewings on leaves, cocoons, galls, and flattened areas in the grass are all signs that wildlife is using, or has used, an area. These can be as exciting to find as the animal itself, for each one is part of the life and story of that creature.

3 *Several days before the trip*, make the following preparations. Explain to the class that on their upcoming field trip they will be doing an activity called "Who Lives Here?". Working in teams of two, they will hunt for signs of wildlife along the trail. To mark their discoveries, the teams need "flags" to put in the ground.

Make Flags in the Classroom

4 *Directions for "flags":* Pass out ten sticks or bamboo skewers, and ten strips of yarn or survey tape, to each team. Also pass out colored markers to each team. Team members should tie the yarn strips securely onto the skewers. (Double knots are recommended.) Teams should choose a design to color on their flags to identify them as their own. These marks, whether patterns, symbols or numbers, must be put consistently on each flag to aid in recognizing them on the ground. When these tasks are completed, secure each team's flags together with a rubber band and save them for the field trip.

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The Day of the Activity

Before the activity begins, *enlist the active participation of the chaperones/accompanying adults*. Make sure that they understand that you will need their help monitoring the team exploration segment, and assisting with group management. You may even want to assign several teams for each adult to oversee specifically.

Give Clear Directions

Give clear directions, and set still clearer expectations. The freedom of this activity necessitates control for those who are easily excited and eager. Protecting the students from the resource and the resource from the students requires firm physical and behavioral boundaries.

Importance of Physical Boundaries

Physical boundaries should be understood by all. No one will go past the rock on the trail, into the drainage, or back down the trail past the big cottonwood tree are some typical boundary markers to choose. The teacher also needs to make an understanding with the group that no one will go climbing on rocks, trees, or into unsafe situations.

Do Not Touch or Disturb Wildlife

Some words of warning about touching, catching, or collecting wildlife are essential. As a part of the National Park Service, Colorado National Monument does not allow collecting of rocks, plants, artifacts, bones, lizards, insects, bird feathers, or any other "treasures" found within its boundaries. Everything is protected under federal law so that they may remain part of the complex of ecosystems in the National Parks, into the future. By leaving things as they are, visitors have a remarkable opportunity to ensure that our children and their descendants can also visit and appreciate the marvels that we discover today. Thus, if students find something special along a trail, be it a rock, flower, lizard, or insect, look at it, enjoy it, and mark it with a flag. Show it to others in the group, but leave it where it is.

Another element of protecting the resource and the student is the rule: Do not disturb wildlife. This includes things big and small, mammals, birds, amphibians, reptiles, fish, even tiny insects, and spiders. This means that splashing in a creek where frogs have laid their eggs is not acceptable. Climbing on a rock where peregrine falcons or other birds are nesting, or throwing rocks to make a rabbit or snake move, are forbidden. For your safety, do not pet, feed, or handle any wildlife. Some animals can carry disease, while others can inflict painful bites. If you do spot wildlife in the monument, stop, stand still, and watch it. By keeping your noise and movements to a minimum, you may be able to observe a lizard catching a fly, a deer chewing its cud, a raven bringing nesting material to its mate. Thousands of stories and dramas unfold around the monument every day. See how many your team can discover.

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Protect Cryptobiotic Soil Crust

Protect cryptobiotic soil crust. Do not walk on these fragile black-to-brown-to-gray crusts growing on the soil and under trees.

Cryptobiotic soil crust is a fascinating assemblage of plants, algae, fungi, and lichens that is marvelously adapted to survive under harsh conditions with little water. It pioneers the creation of soils, growing, aerating, penetrating, and improving dry desert sands for the benefit of other plants. To continue its vital role, this tiny, fragile habitat needs protection. Not only must we be careful where we step, but we must remember that we are only visitors to these soils. Our passage through this environment should benefit it, not destroy it. For more information on this fascinating and vulnerable soil crust, look in the chapter on Plants for the activity, "The Magic of a Drop of Water."

Consequences of inappropriate or unsafe behavior are often most effective when determined by the students themselves. If this approach is not appropriate for a group, then the teacher may want to state that teams that do not follow the activity will sit out the remainder of the exploration. All groups having adults visible and involved to answer questions or help with problems makes a big difference.

The activity begins with directions to the teams. For some groups, acting out exactly what will happen on a small scale will be useful.

When the group arrives at the area chosen by the teacher to explore, each team (and their flags) will be taken to a predetermined site.

On "their territory", the team has 15 - 20 minutes to explore, and find as many signs of wildlife use as possible. Every time the team members find an animal home, track, scat, or other sign, they should place a flag in the ground by it.

Nothing should be moved or disturbed in this process. A marker is merely placed nearby to indicate the discovery. If wildlife is seen, a flag can be placed to designate its location. After the territory has been fully explored, and all flags placed, the team may return to the leader leaving their flags behind. Part One is now complete

Note: Placing the flags should NOT to be done quickly. Each team must do a careful inspection of their lands so that nothing is overlooked. Some sites may have fewer than ten signs of animal usage. That is all right.

In Part Two, teams switch sites. For example, Team 1 goes to Team 4's site; Team 2 to Team 5's location, etc.. The exchange of site is based on the timing of teams' returns to the teacher. Those done first go out to another site first.

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On the second territory, the team hunts for the flags that were placed by the previous team. When a flag is found, team members must look closely in the area to identify what the first team discovered there. Then, the second team PICKS UP the flags from the previous team. If a flag cannot be located, students who get done quickly can help to recover it.

Thus, every team explores two areas. On the first territory, they hunt for signs of wildlife, and place flags by them. On the second, they collect the flags designating wildlife signs found by another team. By visiting both sites, students have the opportunity to know two pieces of land, and to see how wildlife usage may be similar — or different — on each one.

A vital third part of "Who Lives Here?" is a review of what was discovered by the teams. It may be done in the classroom after the field trip, or it may be done in the field as part of the activity. The latter has the advantage of the information being fresh in the minds of the students, resulting in their making better connections and seeing more patterns.

After all the flags have been located, gather the teams back together to share what they saw and learned. The teacher may want to use a large sheet of paper and a marker to make a map of all the territories, and list the sightings of each team on it. Next, ask the teams to evaluate their findings, especially noticing patterns of wildlife usage. Team C may have 15 signs of animal usage within their area, where Team D found only three. Why would that be? Is it because there is a cottontail burrow, therefore numerous tracks and scat on Team C's land? Is it because there is less accessible (therefore less usable) terrain on Team D's territory? Deer tracks were on ten of the twelve sites. Why would that be? What does the plant life look like on the ten sites with deer tracks? What does it look like on the other two? Where does the drainage run? How does its presence affect patterns of wildlife usage? These and many more questions may be addressed in the analysis portion of "Who Lives Here." This component of the activity is very reminiscent of what wildlife biologists and land use planners do when they make studies of a piece of land.

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Tips for making the exercise go smoothly:

- Teams should be well spaced so that territories do not overlap.
- Flags should be placed at any sign of wildlife or wildlife use. The uses do not have to be fresh. For example, a spider web, an ant hill, unknown mammal scat, an old woodrat nest in rock, recent diggings under a rock, an old bone, a tiny bird hiding in a sage brush, and a lizard with a long tail on a rock might all be found on one piece of land.
- The teacher should encourage the class to make their "best guess" when trying to identify sign or object. The point of this exercise is to encourage and foster observation, a skill that is critical to the success of any wildlife biologist or animal behaviorist. No doubt there will be a range of knowledge within the class. Where discussions or differences come up, settle them with a reference to a field guide, or by validating that many possibilities exist because we did not see exactly who made the track or scat. Guesses and "guesstimates" about what made the track or dropped the feather are all valid.
- Emphasize that flags should be placed so that they are visible, and easily retrieved.
- If a team gets done too quickly, send them back to look for more signs in their area. Have them report back to you with any additional sightings they make. No more flags need to be put out.
- If the teacher uses the large piece of paper for mapping, he or she may want to draw a diagram of the area while the students are out on their territories, or complete it from field notes before the outing.
- Before leaving the area, make sure that all flags have been found and properly stored in packs. No trash or signs of the group's visit should be visible.

Who Lives Here?

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Conclusion

"Who Lives Here?" is an exploration of an area that is used by wildlife now and in the past. Students are given freedom to explore their piece of land for signs of what has used the trees, shrubs, plants, grasses, rocks, and soil. By marking their discoveries with a "flag", they allow others to visit their site and see things through another person's eyes. Discussions and mapping of what was found offer opportunities for comparison of information. Patterns of wildlife use, challenges of topography, and conditions that make a piece of land usable for a variety of creatures are all brought forth through this activity. While the discoveries must take place in the field, numerous opportunities for classroom follow-up, and integration of science, math, and language arts curriculum are available.

Extensions

1 Map-making. Students use a blank piece of paper to draw in topographic features of their territory on it. Trees, rocks, drainages may all be recorded with simple shapes or words. Then, using different colored pencils or markers, students draw in the wildlife signs that they found, and their locations. This activity can be done by memory after the activity, or on site with older students. Maps can be compiled into a collage that represents the area as a whole. Another option is to organize the maps in relation to each other, much like assembling a large puzzle. Together the group looks for patterns of use and pathways that might link the different areas.

2 Research reports on the animal signs and tracks may be done in the classroom. Each team picks a track, scat, feather, nest, or other wildlife sign that they want to learn more about. Using the school library, area libraries, bookstores, and even the Internet, they can search for information about their chosen subject. An open pinyon cone could lead one team to research pinyon trees, and another to learn about rodents of the area, or pinyon jays. The reports could be written, produced as plays, given orally, or shared in a variety of methods that the students choose.

Wildlife Observation Sheet

ACTIVITIES FOR STUDENTS

1. Name of creature seen (if known): _____

2. Number of creatures seen: _____

3. How well did you see the creature? (Check one of the answers.)

   ☐ Excellent view (could see creature close up and in detail)
   ☐ Good view (could recognize creature and what it was doing)
   ☐ Saw briefly (creature was moving and in sight for a short time)
   ☐ Heard only (sound of creature was heard: i.e. coyote, great horned owl, woodpecker, etc.)

4. Location: (Please be as specific as possible. For example: Seen on Rim Rock Drive, just below canyon rim, at Cold Shivers Overlook.)

   _____
   _____
   _____

5. Date and time of sighting: _____

6. Weather conditions at time of sighting: _____

7. What was the creature doing when seen?
   (For example: sitting, flying, sleeping, basking in sun, etc.)

   _____
   _____

8. Have you ever seen the creature before? ☐ yes ☐ no

9. Check the signs of the animal's activity or territory that you saw.

   ☐ Nest/burrow ☐ Tracks ☐ Scat
   ☐ Bedding areas ☐ Diggings ☐ Rubbings
   ☐ Fur/feathers ☐ Food remains ☐ Other _____

10. Comments or description of creature:

   _____
   _____
   _____

Your Name _____

Town/State _____

School/Class _____ Date of this report _____

Animal Signs

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Reference Obj. 4.26 4.04 Thinking Obj. 4.06 4.07 4.17 **Standard 3** 4.01 4.04 4.05 4.06 4.09 **Standard 4** Listening Obj. 4.01 4.02 4.05 4.06 4.08 Thinking Obj. 4.03 4.14 4.15 4.16 4.17 4.20 4.07 4.08	**Standard 3** Reading Obj. 5.05 5.06 5.11 **Standard 4** Listening Obj. 5.02 5.05 5.06 Reference Obj. 5.18 Thinking Obj. 3-5.01 3-5.04 3-5.15 3-5.17 **Standard 5** Reading Obj. 5.01 5.23	**Standard 1** 6.20 6.22 6.25 **Standard 2** 6.18 **Standard 3** 6.01 6.06 **Standard 4** 6.34 6.35	**Standard 1** 7.15 7.19 7.22 7.43 **Standard 4** 7.01 7.24	**Standard 4** 8.01 8.14 8.17 8.20
Math	**Standard 1** 4.1.3 **Standard 3** 4.3.1	**Standard 2** 2.1 **Standard 3** 3.4 3.5 3.6 3.7 **Standard 4** 5.4.1 **Standard 5** 5.2 5.6	**Standard 4** 4.1 **Standard 5** 5.2 5.6	**Standard 5** 5.2 5.6	**Standard 2** 2.1 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.6

Animal Signs

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** **2.1** 2.11 2.12 **Standard 3** **3.1** 3.12 3.14 **3.2** 3.22 **3.3** 3.33 **3.4** 3.43 **Standard 5** 5.01 5.05 **Standard 6** 6.03 **Standard 7** 7.04 7.05	**Standard 1** 1.03 1.05 1.06 1.07 1.08 **Standard 2** **2.1** 2.11 **Standard 3** **3.1** 3.11 3.12 3.13 3.15 **3.2** 3.22 **3.4** 3.43 **Standard 5** 5.04 **Standard 6** 6.01 6.02 **Standard 7** 7.02 7.05 7.06	**Standard 1** 6.1.03 6.1.04 6.1.05 6.1.06 6.1.07 6.1.08 6.1.12 **Standard 2** **2.1** 6.2.01 **Standard 3** 3.1 **Standard 5** 6.5.03 **Standard 7** 6.7.02 6.7.05 6.7.06	**Standard 1** 7.1.03 7.1.04 7.1.05 7.1.06 7.1.07 7.1.08 7.1.12 **Standard 2** **2.1** 7.2.01 **Standard 3** **3.1** 7.3.01 **Standard 5** 7.5.03 **Standard 7** 7.7.05 7.7.06	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 **Standard 2** **2.1** 8.2.01 **Standard 3** **3.1** 8.3.01 8.3.02 8.3.03 **Standard 5** 8.5.03 **Standard 7** 8.7.05 8.7.06
Social Studies	**Geography** **Standard 2** 4.44 4.49	**Geography** **Standard 4** 5.18 5.38	**Geography** **Standard 4** **4.1** 6.35 6.36 **4.2** 6.38	**Geography** **Standard 2** **2.1** 7.35	**Geography** **Standard 2** **2.1** 8.18 **Standard 4** **4.1** 8.40

Lizard Patrol

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Writing Obj. 4.07 4.08 4.12 Speaking Obj. 4.03 4.09 4.10 Reference Obj. 4.04 4.07 4.26 Thinking Obj. 4.02 4.06 4.07 4.17 **Standard 2** 4.10 4.11 **Standard 3** 4.05 4.08 4.09 4.10 4.17 4.18 4.19 **Standard 4** Reading Obj. 4.09 4.11 4.12 Listening Obj. 4.01 4.02 4.03 4.05 4.08 **Standard 5** Thinking Obj. 4.06 4.04 4.18 **Standard 6** 4.14 4.17 4.18	**Standard 1** Writing Obj. 5.05 5.07 Speaking Obj. 5.06 5.10 Reference Obj. 5.04 5.06 5.09 5.10 Thinking Obj. 3-5.18 **Standard 3** 5.05 5.06 5.09 5.12 **Standard 4** Reading Obj. 5.11 5.20 Listening Obj. 5.02 5.03 5.05 5.08 5.09 5.10 Speaking Obj. 5.11 Thinking Obj. 3-5.01 3-5.04 3-5.17 **Standard 5** 5.17 **Standard 6** 5.02 5.14 5.16 5.21 5.19	**Standard 1** 6.20 6.22 6.25 6.28 6.29 6.37 **Standard 2** 6.15 6.18 6.19 6.24 **Standard 3** 6.01 6.06 6.07 6.09 6.12 6.14 **Standard 4** 6.09 6.10 6.20 6.21 6.22 6.25 6.27 6.28 6.35 6.47 **Standard 6** 6.11 6.12 6.29	**Standard 1** 7.15 7.19 7.21 7.22 7.26 7.30 7.43 **Standard 2** 7.16 7.17 7.18 7.23 7.33 **Standard 3** 7.01 7.04 7.05 7.06 7.08 **Standard 4** 7.11 7.12 7.24 7.26 7.27 7.28	**Standard 1** 8.11 8.14 8.16 8.17 8.32 8.33 **Standard 2** 8.12 8.13 8.18 8.21 **Standard 3** 8.01 8.02 8.03 8.04 8.06 8.10 **Standard 4** 8.14 8.20 8.23

Lizard Patrol

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Math					
Science	**Standard 2** 2.1 2.11 2.3 2.31 **Standard 3** 3.1 3.12 3.14 **Standard 7** 7.04 7.05	**Standard 2** 2.1 2.11 **Standard 3** 3.1 3.12 3.14 3.4 3.43 **Standard 7** 7.05 7.06	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.07 6.1.08 6.1.12 **Standard 2** 2.1 6.2.01 **Standard 3** 3.1 **Standard 7** 6.7.02 6.7.05 6.7.06	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 7.1.12 **Standard 2** 2.1 7.2.01 **Standard 3** 3.1 7.3.01 7.3.02 7.3.03 3.2 7.3.04 **Standard 7** 7.7.02 7.7.05 7.7.07	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 8.1.12 **Standard 2** 2.1 8.2.01 **Standard 3** 3.1 8.3.02 8.3.03 **Standard 7** 8.7.02 8.7.05 8.7.06
Social Studies	**Geography** **Standard 2** 4.46 4.47 **Standard 4** 4.64 4.67	**Geography** **Standard 1** 5.18 **Standard 4** 5.18 5.38	**Geography** **Standard 4** 2.1 6.21 4.1 6.35 4.2 6.38	**Geography** **Standard 2** 2.1 7.35 7.36 **Standard 4** 4.1 7.59 7.60 4.2 7.62 7.63	**Geography** **Standard 2** 2.1 8.18 8.19 **Standard 4** 4.1 8.40 8.41

Stalking

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 4** **Listening Obj.** 4.01 4.05 4.06 4.08 **Thinking Obj.** 4.15	**Standard 4** **Listening Obj.** 5.02 5.05 5.08 **Thinking Obj.** 3.5.15	**Standard 4** 6.06 6.09 6.25	**Standard 4** 7.24	**Standard 4** 8.23
Math					
Science	**Standard 3** 3.1 3.12 3.14 3.2 3.22 **Standard 6** 6.02	**Standard 3** 3.1 3.12 3.13 3.2 3.22 3.24 3.4 3.43	**Standard 7** 6.7.02 6.7.03	**Standard 3** 3.1 7.3.01 7.3.02 3.2 7.3.06 **Standard 7** 7.7.02 7.7.03	**Standard 3** 3.1 8.3.03 **Standard 7** 7.7.02 7.7.03
Social Studies	**Geography** **Standard 2** 4.46 4.47 **Standard 4** 4.67	**Geography** **Standard 4** 5.18 5.38	**Geography** **Standard 4** 6.35 6.36	**Geography** **Standard 4** 7.59 7.60 7.62 7.63	**Geography** **Standard 4** 8.40 8.41

Who Lives Here?

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Speaking Obj. 4.06 4.10 4.09 Reference Obj. 4.26 Thinking Obj. 4.02 4.06 4.07 **Standard 4** Listening Obj. 4.01 4.05 4.08 Thinking Obj. 4.03 4.14 4.16 4.07 4.08 **Standard 5** Thinking Obj. 4.06	**Standard 1** 5.03 5.01 5.06 5.10 3-5.18 5.22 **Standard 2** 5.08 **Standard 4** Listening Obj. 5.02 5.03 5.05 5.08 Speaking Obj. 5.11 Reference Obj. 5.18 Thinking Obj. 3-5.01 3-5.04 3-5.17 **Standard 5** 5.23 5.03 5.06	**Standard 1** 6.25 6.29 **Standard 4** 6.25 6.27 6.28 6.33 6.34 6.35	**Standard 1** 7.31 **Standard 4** 7.24	**Standard 4** 8.17 8.23 **Standard 5** 8.33
Math	**Standard 1** 4.1.3 4.1.5 **Standard 3** 4.3.1 4.3.2 4.3.3 **Standard 5** 4.5.3b	**Standard 2** 5.2.1 5.2.3 **Standard 3** 5.3.1 5.3.2 5.3.3 5.3.4 5.3.7 **Standard 5** 5.5.2 5.5.3 5.5.6	**Standard 2** 2.1 2.2 **Standard 3** 3.1 3.3 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.3 5.6	**Standard 2** 2.1 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.3 5.6	**Standard 2** 2.1 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.3 5.6

Who Lives Here?

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** **2.1** 2.11 **Standard 3** **3.1** 3.12 3.14 **Standard 5** 5.05 **Standard 6** 6.01 6.02 6.03 **Standard 7** 7.01 7.02 7.03 7.04 7.05	**Standard 1** 1.03 1.05 1.06 1.07 1.08 **Standard 2** **2.1** 2.11 **Standard 3** **3.1** 3.11 3.12 3.14 3.15 **3.2** 3.22 3.24 **3.4** 3.43 **Standard 5** 5.04 **Standard 6** 6.01 **Standard 7** 7.02 7.03 7.05 7.06	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.07 6.1.08 6.1.10 **Standard 2** **2.1** 6.2.01 **2.2** 6.2.03 **Standard 5** 6.5.03 **Standard 7** 6.7.05 6.7.06	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 7.1.12 **Standard 2** **2.1** 7.2.01 **2.2** 7.2.04 **Standard 3** **3.1** 7.3.01 7.3.03 **Standard 5** 7.5.03 **Standard 7** 7.7.02 7.7.05 7.7.06	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 8.1.12 **Standard 2** **2.1** 8.2.01 **2.2** 8.2.03 **2.3** 8.2.07 **Standard 3** **3.1** 8.3.01 8.3.02 8.3.03 **Standard 5** 8.5.03 **Standard 7** 8.7.02 8.7.05 8.7.06
Social Studies	**Geography** **Standard 2** 4.44 4.46 4.49 4.50 4.52 **Standard 4** 4.63 4.67	**Geography** **Standard 4** 5.18 5.38	**Geography** **Standard 4** **4.1** 6.35 6.36 **4.2** 6.38	**Geography** **Standard 1** **1.2** 7.26 7.27 **Standard 2** **2.1** 7.35 7.36 **Standard 4** **4.1** 7.59 7.60 **4.2** 7.62 7.63	**Geography** **Standard 1** **1.2** 8.14 **Standard 2** **2.1** 8.18

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CHAPTER FOUR

Geology

of Colorado National Monument

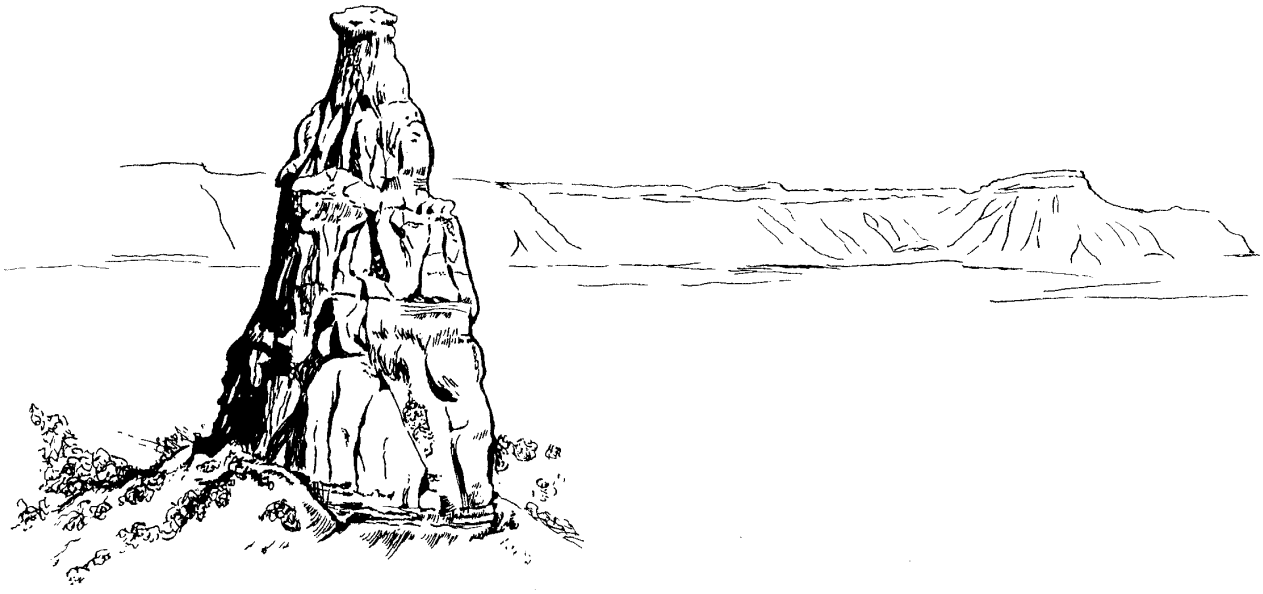
Photo from *Through the Eyes of the Children*
by Diane Hirschinger Gallegos and Tope Elementary Students

The Rocks Before You

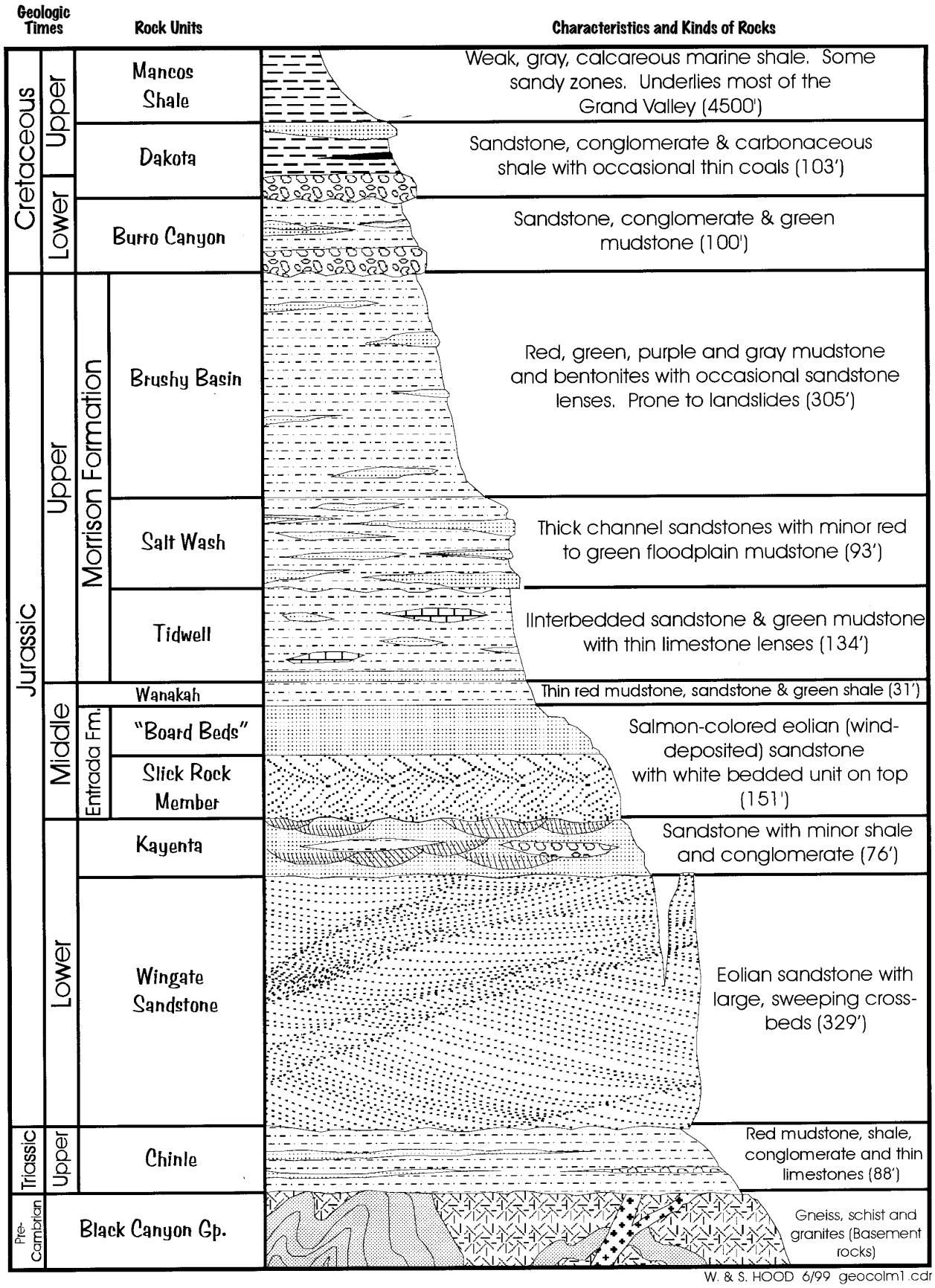
The concept of geologic time is a remarkable one. Like little else, it forces one to see how small and insignificant humans are in the span of life on our planet. Looking at the canyons of Colorado National Monument sparks musings such as, "How did things come to be as they are, and what might happen in the future?" In the exposed rock are tales of changing environments and climates, of creatures and plants living and dying. The folds of the land speak silently but powerfully of forces so great and so enduring that we can scarcely fathom them. Every vista point, cliff, and boulder-strewn slope offers up clues to the past. The canyon bottoms, drainages, and waterfalls demonstrate processes that are vital to the creation and the cycling of the Earth's crust. The rocks before us have many stories to tell if we take the time to look.

Introduction: Taking Geology Into the Field

Schoolchildren, who have a difficult time conceptualizing the age of a parent, or how long until lunch, have a very hard time grasping the meaning of millions, much less billions, of years. They are more interested in the concrete: finding out what something is. "What is this rock?" is their way of getting a handle on larger, less answerable questions posed by their surroundings. Because they can imagine a desert or an ocean, the information about the rock formations that follows concentrates on what the area would have looked like when the rock was created. Descriptions of how the rocks look today; where they can be found; and how they got their names are given more attention than the age of the rocks. This information is to give teachers and trip leaders a working knowledge of the rock formations so that they will be successful and comfortable with taking geologic studies out of the classroom and *into* the field.



Stratigraphic Column of Colorado National Monument



The Rocks Before You

Part 1: Geologic Review

When geologists study the Earth, they make and refer to **geologic maps**, which portray the different kinds of rock *exposed on the surface*, as if all the soil were stripped off of a given area. In contrast, **geologic columns** or **stratigraphic columns** summarize an area's geology *below the surface*. The columns show views of an area as if it were cut open for you to look at the layers piled up on top of each other from the side. These one-dimensional stacks depict thickness and relative age of rock units in a given area. The rock layers are shown in sequence from the oldest layer, at the bottom, to the youngest layer, at the top. Sometimes the sequence varies or is altered due to uplifting, faulting, or erosion. Occasionally the sequence has a gap, where rocks of a certain time period are missing. Known as an **unconformity**, what is missing from the stratigraphic column can be as telling about an area, and as interesting to geologists, as what is captured in the rocks.

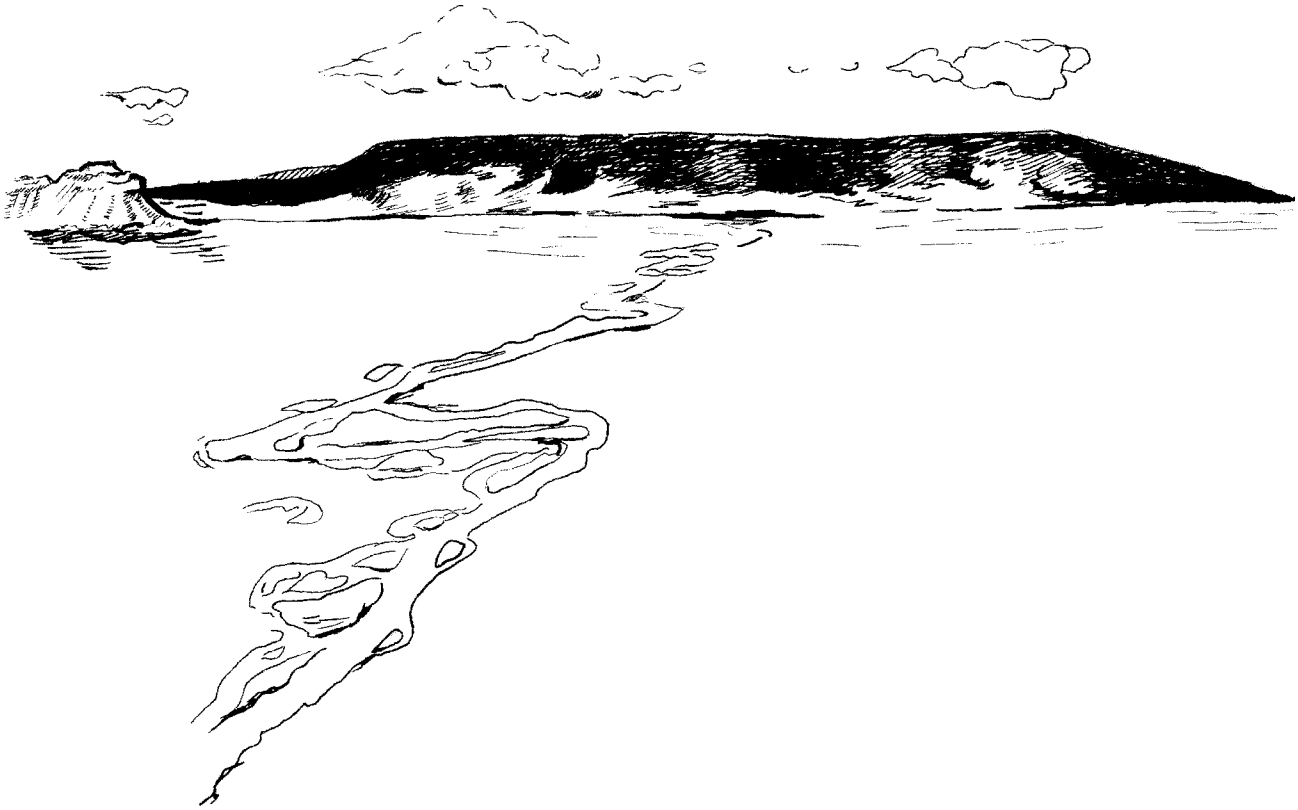
Geologists study the rocks before them using such terms as formations, members, layers, strata, beds, and lamina(e). These words are helpful for distinguishing large sections of rock from the tiniest tier. **Formations** are mappable units of rock that are similar throughout, with a distinguishable bottom and top. Created under the same conditions, such as an ocean or a desert, and during a single period of time, they are different from rocks that are above and below them. Some formations are made up of only one kind of rock, such as sandstone. In this case, the term "formation" is sometimes dropped and the kind of rock is substituted. Wingate Sandstone, for instance, is an impressive cliff-forming rock of a single kind of rock: sandstone. The Burro Canyon Formation, on the other hand, includes mudstones, siltstones, shales, cherts, and sandstones.

The Rocks Before You

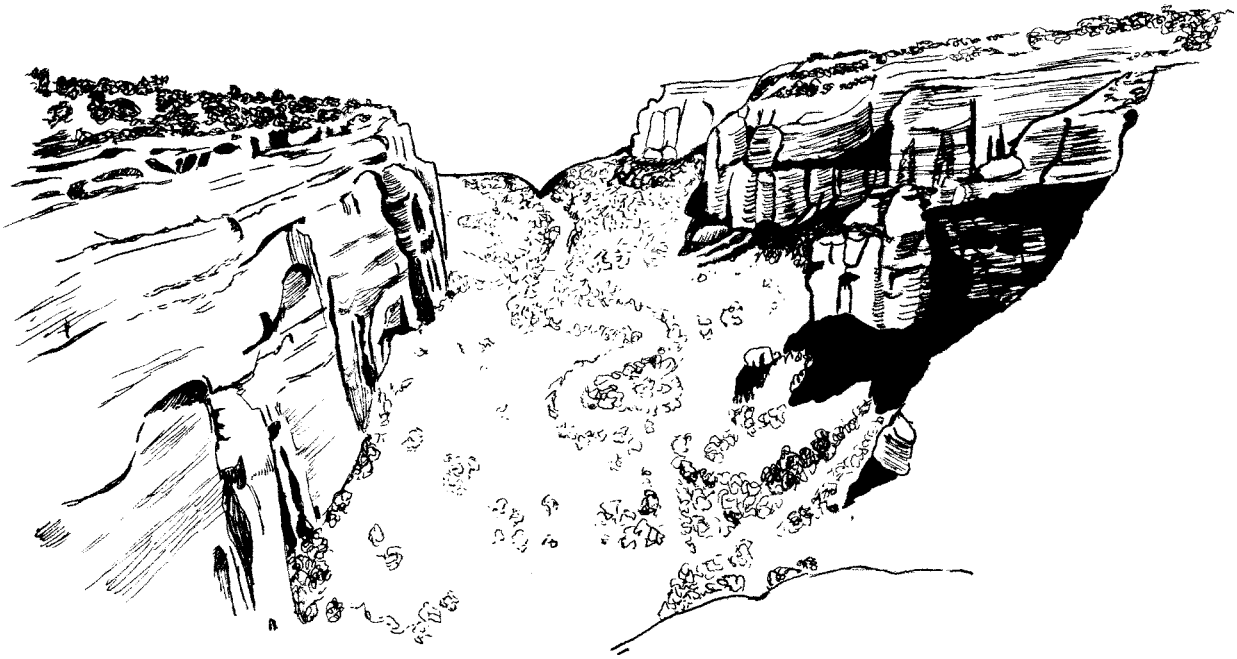
Another term used to describe formations that exhibit a variety of rocks, or sub-units within a larger grouping, is **members**. For example, in the Morrison Formation, different conditions existed on the land over an extended period of time. In some places there are rock lenses of ancient sand bars from long ago rivers. Fine-grained muds from the quieter water of lakes are also found. Even beds of volcanic ash are seen. Consequently, the Morrison is divided into the Brushy Basin, Salt Wash, and Tidwell members. Entrada Sandstone also has different members, some deposited during a marine environment, and others developed in sand dunes alongside the marine habitat. When discussing an area as large as the one that many of these formations covered, it is not surprising that underlying surface conditions, or micro-climates on the ground, would affect the nature of the rocks being created.

The terms **layers** and **strata** and **beds** are used interchangeably, all describing smaller, often horizontal, units of rock that exhibit similar characteristics. Within a formation, strata may vary in color, grain size, thickness, yet still have enough in common to be linked together. **Laminae** (singular) and lamina (plural) are the individual, thin layers of rock that are one centimeter or less in thickness and make up a larger strata.

Many classes will not venture deeply enough into the basics of geology to need these words and definitions. Still, these terms are useful underpinnings for any exploration of the rocks before you at Colorado National Monument.



The Rocks Before You



Part 2: Geologic Formations of Colorado National Monument

When describing rocks in a stratigraphic column, geologists begin with the oldest rock at the bottom. They move upwards through the formations to the uppermost, and youngest, rock. Thus, in the "Rocks Before You", the Precambrian rock at the bottom of the canyons is the starting point, and the Dakota Sandstone, at the highest point in Colorado National Monument, is the finish.

The Rocks Before You

Precambrian Rocks

Precambrian rocks make up a significant part of Colorado National Monument. They underlie all the other rocks, forming the floor, or "basement rock", of all the canyons. Their dark gray to black color stands in somber but striking contrast with the reds, oranges, browns, tans, and grays of the rocks above. One common Precambrian rock, called **gneiss** (pronounced "*nice*"), has distinctive layers of minerals. Quartz creates the white or translucent color, feldspar creates the pink color, and biotite, a form of mica, creates the black color. Some rocks are beautifully laced with large-sized crystals of feldspar and quartz. Other rocks are intruded by mixtures of smaller crystals of white, pink, and black color. Dark-colored granite also occurs in the Precambrian of the monument. (For more information on colors in rocks, see "White to Black and In Between".)

Precambrian rocks represent the oldest known rocks, having been dated in some parts of the Earth as over four billion years old. Here at Colorado National Monument, preliminary radiometric age dates indicate that they are about 1.7 billion years old. Because they go back to the beginnings of the Earth's history, they are of great interest to geologists. Yet studying these rocks is not easy, since many clues to the past have been obliterated by the enormous changes through which they have gone. For instance, most Precambrian rocks lack fossils, a tool widely used in geologic dating. Mineral composition and content must be utilized instead.

The Great Unconformity

One fascinating feature of the rocks at Colorado National Monument is the rocks that are missing. There is a huge gap in geologic time represented by the contact between the Precambrian rocks and the overlying Chinle Formation. About one and one-half billion years of geologic history are represented by that gap. That's about one-third of earth's history! Geologists call gaps like this "unconformities" and local geologists call this one "The Great Unconformity" because it represents so much lost time. But the fact that there is a huge gap in the rock record tells us a lot in itself. Nearby, there are many rocks formed between the Precambrian and the Chinle. From the character of these rocks geologists have determined that this area rose up as part of a large mountain range that extended from New Mexico into Utah. This happened in late Pennsylvanian time, roughly 300 million years ago. The mountains were eroded for a hundred million years until they were finally worn low enough that the Chinle was deposited on them. So the "gap" tells the story of an incredible amount of erosion, the debris of which was deposited far across the southwest and makes up some of the rocks that we see in other national parks.

The Rocks Before You

BACKGROUND FOR **TEACHERS**

Chinle Formation

The Chinle Formation rests atop the Precambrian rock. This sedimentary shale and sandstone unit stands in sharp contrast to the dark basement rock below, and forms broad brick-red to brown colored slopes. On close inspection, beds of purple and gray can occasionally be found. Highlighting these colors are green shrubs seemingly sprinkled across the slanted Chinle outcrops. Many boulders have also fallen onto it from the steep cliffs above. If you stand at the canyon rim and look down, the Chinle rocks seem to be pressed out of the sequence of formations by the weight of the towering canyon walls above. In some places, the strata seem to fan out symmetrically, like a skirt with a petticoat underneath.

The Chinle Formation is a significant indicator of changes in environmental conditions of the region. The base of the Chinle marks an unconformity in the rock, a gap in the time sequence of rock layers. Whereas the Precambrian rock dates back to 1.7 billion years ago, the Chinle dates to the Triassic times, approximately 210 to 230 million years ago. The missing rocks are a mystery, but geologists think that for millions of years, rocks were deposited in the area only later to be eroded away. This left a smooth, beveled surface on the Precambrian rock, on which the Chinle Formation currently rests.

Chinle rocks formed during a time when seas were far away to the south and the west of the area, and the Ancestral Rockies were eroding to the east. Streams flowing from east to west brought in great loads of sediment, depositing them across flood plains and lowlands that existed in the region. Some areas were covered by ponds and lakes. Much of the sediment was thus fine-grained, and eventually compacted and solidified to create shale. Other rock was more coarse-grained, forming sandstone lenses and sections of conglomerate rock. The area must have been heavily vegetated with cycads, conifers, and ferns given the number of plant fossils and specimens of petrified wood that have been found. Dinosaur and reptile tracks are also known to occur.

While not a thick formation at Colorado National Monument, near Holbrook in northern Arizona, the Chinle is exposed in high and colorful slopes in an area known as the Painted Desert. Nearby is Petrified Forest National Park, which was set aside to preserve a remarkable concentration of fossil logs that weathered out of the rock. Not far away is the Chinle Valley from which these shales get their name.

The Rocks Before You

BACKGROUND FOR **TEACHERS**

Wingate Sandstone

Wingate Sandstone rises steeply above the softer Chinle Formation. This sandstone is possibly the most striking rock formation in Colorado National Monument, as well as in many parts of the southwest. It is characterized by huge red, orange, and brown cliffs that rise over 300 feet high. Dark patinas of desert varnish are common on the rock face. Up close the Wingate Sandstone is very striking because you can see how it is composed of tiny grains of sand tightly compacted and cemented together. Over 200 million years in age, the cliffs tell stories of a long-ago desert that stretched across this region, replacing the fresh-water environments of the Chinle times. Geologists speculate that the Wingate climate was similar to the present day Saharan Desert in Africa, with miles of sand dunes blown by the wind, shifted first in one direction, then in another. With your finger, you can trace the movements of the sand by that ancient wind in the cross-bedding found throughout the strata. Called an eolian (carried by the wind) deposit, the wind is now a factor in the Wingate's erosion.

Striking exposures of Wingate Sandstone are found throughout southeastern Utah, northern Arizona, northern New Mexico, and southwestern Colorado. The name was given during western surveys of the 1880's for a sandstone cliff outside of Fort Wingate, New Mexico. Later, the set of cliffs east of Gallup was found to be Entrada Sandstone, not Wingate, but the name was retained.

A striking feature of Wingate Sandstone cliffs is how they fracture in long vertical lines, called joints. Freezing and thawing, heating and cooling, winds, water, and other forms of erosion and weathering seem to cause the Wingate to break down quite easily. The effects of the elements on the desert sandstone are dramatically exhibited in the decaying mounds of Wingate Sandstone known as the Coke Ovens. Standing at the Coke Ovens Overlook, or at the end of the Coke Ovens Trail, you can see how a once massive rock wall has worn away to leave behind beehive shaped mounds resembling the dunes of their origin.

Among the beauties of the canyons of Colorado National Monument is the Wingate Sandstone. From one end of the park to the other, the sheer, massive cliffs highlight spectacular vistas and breathtaking drops. Many overlooks and trails offer dramatic views of it. Independence Monument View, Artists Point, Red Canyon Overlook, and Cold Shivers Point are especially notable. Near to the Visitor Center, short hikes, such as Otto's Trail, Window Rock Trail, and Canyon Rim Trail, bring you right to the canyon rim for excellent sightings of the cliffs. On the east side of the monument, Serpents Trail, Devils Kitchen, and No Thoroughfare Canyon Trails are other locations from which to enjoy the Wingate. Trips along Rim Rock Drive give close-up perspectives, especially near the three tunnels that have been constructed through Wingate Sandstone.

The Rocks Before You

Kayenta Formation

Next in the stratigraphic column is the Kayenta Formation. It contrasts strongly with the tall, fractured cliffs of Wingate Sandstone that lie below it, and the smooth, rounded cliffs of Entrada Sandstone that rise above it. Sandwiched between these two periods of sand dunes and desert, the red beds of Kayenta look like layers of cheese or peanut butter between two thick pieces of bread. Not only does it form a much narrower band of rock, one that is about 75 feet thick, but it is also more brightly colored, and more hospitable to vegetation than its neighbors. Its red, gray, and beige-colored sand and siltstones are highlighted by the dark greens of pinyon and juniper trees. Created when streams crisscrossed this area, the Kayenta is considered to be a fluvial formation. Dissolved silica, likely carried in the water that permeated the sediments washing into the area, filled in spaces between the sediments and solidified into a strong cement between particles. Geologists estimate Kayenta rocks to be about 190-195 million years old.

Of note is that the Kayenta Formation is the surface on which much of Rim Rock Drive atop the mesa is situated. The flat area with the wide views where the Visitor Center is located is also on Kayenta rock. Other places where it can be seen are the Alcove Nature Trail, Coke Ovens Trail, Independence Monument View, Cold Shivers Point, Devils Kitchen Trail, Serpents Trail, and No Thoroughfare Canyon Trail. Otto's Trail and Overlook give one of the best views of Kayenta in its role as a caprock for many monoliths.

Hard Kayenta sandstone is resistant to erosion. It acts as a barrier to the elements, slowing down the effects of weathering on the Wingate Sandstone below it. If you look closely at such features as the Kissing Couple, the Pipe Organ, and Independence Monument, you can see a mushroom-like cap of Kayenta Sandstone that sits atop each one. This shelters the cliffs below, much like an umbrella shelters us from rain or sun. In areas where the Kayenta has eroded, the Wingate Sandstone seems to quickly follow. The fins of rock of which Independence Monument was once a part are examples of this more rapid erosion without the protection of the Kayenta.

The Kayenta Formation was named for Kayenta, Arizona, where thick deposits of it have been studied. While it is up to 250 feet thick in parts of Arizona, at Colorado National Monument it is 80 feet thick at most. Geologists have discovered many interesting plants, fresh water mollusks, fish, and invertebrates within this unit of rock. Also, dinosaur footprints have been located, indicating the beginning of the age of dinosaurs during this time. Thus, the Kayenta serves as a reminder of how much climates can and do change in a given area. From fresh water to desert to fresh water habitat again is encapsulated in the rocks before you. What comes next?

The Rocks Before You

Entrada Sandstone

Entrada Sandstone creates a distinctive band of rounded cliffs that sit atop the Kayenta Formation. Although not as high or as darkly colored as the Wingate Sandstone, the Entrada is easily distinguished by its two tiers of cliffs. The lower (and older) section is characterized by dark pink, salmon, orange, and brown-colored sandstone cliffs up to perhaps 80 feet high. The upper (younger) section is white to pale salmon-colored sandstone that erodes into tall ledges and rock staircases.

Created over 165 million years ago, the Entrada tells stories of wind-blown sand dunes inland from an ancient sea. A close look at the rocks reveals how, even today, they still resemble sand dunes. When you touch the rock, you can imagine a primeval wind, like a paintbrush, sweeping patterns ahead of it across the sand. Whenever the wind changed direction, the sands whirled with it, forming lines going first one direction, then the other. Geologists call them cross-bedding.

The shapes, colors, and textures of Entrada Sandstone may be seen in many parts of western Colorado, Utah, New Mexico, and Arizona. Possibly the most famous outcroppings contain the arches and balanced rocks sculpted by the elements found in Arches National Park, near Moab, Utah. Enjoyment of this topography has led to an expansion of the tourist industry into the southwest deserts. Mountain biking the Entrada "slickrock" has become a passion for some. Since the formation is composed of quartz sand grains held together by cement of calcium carbonate and silica, smooth, wide slopes of hardened dunes offer challenging and unusual conditions for traveling on two wheels. Elsewhere, oddly enchanting "hoodoo" and mushroom shapes have eroded out of the Entrada Sandstone at Goblin Valley, Utah.

Slick Rock Member

Type rocks for the Entrada come from areas 850 feet thick in the San Rafael Swell in west-central Utah. Formed under marine conditions, these rocks are red, orange, and brown. The white to pale salmon-colored rock at Colorado National Monument is thought to have formed farther from the ocean, in dunes and swirling sands that bordered the ancient sea. Because of the diversity of environments, the Entrada has been divided into sub-units called members. The Slick Rock Member, named for the town of Slick Rock, Colorado, forms the rounded cliffs in the monument. The upper, thinner-bedded part is informally called the "board beds". Both parts have a similar composition consisting of quartz sand grains cemented together with calcium carbonate. Because this cement is more easily dissolved than the quartz, what is often left behind when the Entrada Sandstone weathers are the individual grains of sand, which are born away by the wind or water, and reincorporated into future rocks.

Rim Rock Drive is bordered by these distinctive white, pale yellow, salmon, and orange colored sandstone cliffs from the Visitor Center to near the Coke Ovens Overlook. The Saddlehorn Picnic Area and Campground, Alcove Nature Trail, Coke Ovens Trail, Upper Monument Trail, and Otto's Trail all either travel through the Entrada or offer excellent views of its round, smooth outcroppings and cliffs that seem almost polished.

The Rocks Before You

Wanakah Formation

As you move farther up in the stratigraphic column into the younger rocks of Colorado National Monument, the Wanakah Formation is next. Pronounced "Wuh-NAW-kuh", with the emphasis on the second syllable, this is one of the smaller, more difficult strata to identify. Until recently, this section of rock was labeled as the Summerville Formation, and it is described as such in several National Park Service maps and publications. However, new geologic investigations show that the Summerville Formation does not actually reach this part of Colorado. Instead, this layer of rock has been relabeled as the Wanakah. This is a classic example of how geology is always changing and evolving. With careful new mapping comes more and better information on the details of the rocks. The Wanakah Formation at Colorado National Monument is a good example of the progress being made in this science.

Compared to other nearby formations, the Wanakah is very thin, only about thirty feet thick, where it can be seen at all. Much of it is covered over by rock debris and vegetation. When it does crop out, it is composed of fifteen feet of thin, horizontal beds of reddish siltstone topped by approximately fifteen feet of green siltstone. Geologists think that this formation developed approximately 160 million years ago, when a large lake or playa dried up with a return to desert conditions. Located between the more thick, colorful, and dramatic exposures of the Morrison Formation and the Entrada Sandstone, it easy to miss. Yet, to the touch, the Wanakah is soft and crumbly, and much easier to scratch than either of its neighbors. A good place to see it exposed is along Rim Rock Drive at Artists Point.

Morrison Formation

Resting atop the Wanakah Formation is the Morrison Formation. With its bands of pink, red, gray, white, green and purple, this sedimentary rock is very distinctive. The colorful array of siltstones, mudstones, clays, and shales is broken up periodically by thick, tan sandstone ledges. The Morrison developed about 150 to 155 million years ago, during a time when mountains rose to the south and west of what is now Colorado National Monument. Because our area was lower, streams and rivers carrying sediments from the highlands deposited them here. The floodplain included other fresh-water habitats such as lakes and swamps. Fossil remains of cycads, palms, and conifers attest to the variety of plants that thrived in this environment. An even more impressive number of dinosaurs, fresh-water mollusks, turtles, and small reptilians also flourished.

Of all the geologic formations, the Morrison is among the best known because so many remarkable dinosaur fossils have been found within its multicolored rocks.

First described near Morrison, Colorado, similar rocks have since been recognized throughout the Western United States and Canada. Three sub-units, named the Brushy Basin, Salt Wash, and Tidwell Members, are recognized in Colorado National Monument. The Morrison Formation also interests geologists because it contains deposits of uranium.

The Rocks Before You

You can see the Morrison Formation at several locations at Colorado National Monument, including along Rim Rock Drive near Artists Point, and along the Black Ridge Trail. Perhaps the best examples of it are just outside of the Colorado National Monument boundaries. The land on either side of Monument Road as you approach the East (Grand Junction) Entrance is colorfully banded with grays, purples, pinks and whites. A ridge of Morrison stands out just east of Echo Canyon. The Old Gordon Trail offers spectacular views of the layered rocks. Riggs Hill, the Elmer Riggs Quarry just off Redlands Parkway between Highway 340 and South Broadway, is an outcrop of the Morrison Formation where some of the largest bones of the plant-eating dinosaur, *Brachiosaurus*, have been uncovered.

Dinosaur Hill, near Fruita, along Highway 340 and across from King's View Estates has an interpretive trail through Morrison rocks; one huge rock has the mold of an enormous dinosaur leg bone.

Burro Canyon Formation

The Burro Canyon Formation is next in the stratigraphic sequence. It can be recognized in three ways. Sandwiched between the yellow brown marine sandstone cliffs of the Dakota Sandstone, and the variegated fresh-water mud, silt, and sandstones of the Morrison Formation, its bands of green claystones and beds of sandstone and conglomerate are not as visually dramatic as its neighbors. The Burro Canyon Formation creates gentle slopes broken by periodic sandstone ledges but in the monument it is often disrupted by landslides.

The Burro Canyon Formation marks another change of environmental conditions in the region. It also heralds the earliest times of the Cretaceous Period, from 98 to 140 million years ago. Then, sediments from highlands to the west (central and western Utah, and eastern Nevada) were deposited in the lower elevations of eastern Utah and western Colorado, and distributed by streams and rivers. Layers of chunky conglomerate and fine-grained rock alternately formed. Hence, the Burro Canyon Formation contains areas of rounded slopes mixed with ledges and cliffs. Named for Burro Canyon in San Miguel County, Colorado, where it was first detailed, it is also called the Cedar Mountain Formation to the south and west of the Colorado River.

In Colorado National Monument, it can be seen below the towers at the top of Black Ridge, forming a gentle slope below the microwave and radio towers. Outside of the Colorado National Monument, the lower sections of No Thoroughfare Canyon display the mixed gray and green siltstones, mudstones, and shales characteristic of this formation in a band of rock about 100 feet thick. Look for it, too, as you drive northeast along Monument Drive, about two and one-half miles before the East (Grand Junction) Entrance Station. Along South Camp Road, and near the Fruita Bridge that spans the Colorado River, outcrops of it are also visible. The Burro Canyon Formation is perhaps most significant where its sandstone lenses cap Riggs and Dinosaur Hills, slowing down erosion of significant deposits of dinosaur bones buried in the softer Morrison sediments below.

The Rocks Before You

Dakota Sandstone

Dakota Sandstone is the youngest, and therefore the uppermost, formation of rock discussed here. It is found atop Black Ridge, just outside of the highest part of Colorado National Monument, where it stands out as medium-grained, yellow and brownish sandstone cliffs. The radio and microwave towers, as well as the airport beacons, rest on this outcrop of Dakota Sandstone. The Dakota is also found at much lower elevations north of the monument. As you travel southwest along Monument Road toward the East (Grand Junction) Entrance to the monument, a narrow band of cliffs of Dakota Sandstone top the west-facing slope of No Thoroughfare Canyon (on your left). Many boulders have broken off from above and litter the gentler slope below. Another band of Dakota Sandstone occurs in the Redlands area, flanking the Colorado River.

This peculiar arrangement of Dakota Sandstone exposed at the top and the bottom of the monument is the result of displacement and shifting of lands along the Redlands Fault. The fault runs in a northeasterly direction along the edge of the mesa of which Colorado National Monument is a part. Movement along the fault strongly bent and broke the rocks. To the northeast of the fault, the rocks dip beneath the Grand Valley. Where the rocks are unbroken, this landform is called a monocline.

Among the most widespread Cretaceous rocks in Colorado, Dakota Sandstone is familiar to, and used by, many people in the state. It was first identified and described in Dakota, Nebraska, which gives it its name. On the Front Range between Boulder and Colorado Springs, it is one of the more scenic rocks, forming parts of the dramatic rock outcrops and ridges. For example, the “hogback” on Interstate 70, just west of Denver, is a place where the road was blasted through the Dakota, revealing colorful rock layers underneath. In the eastern portion of the state, it holds significant deposits of oil and gas. In the San Luis Valley, the Dakota Sandstone contains ground water important to the agricultural production of that area. Clays have also been mined from the Dakota for use in the porcelain-making operations of Coors Brewing Company. Pockets of coal, oil, and gas have also been found within it.

Dakota Sandstone was formed during the Cretaceous Period. During that time, an ocean, called the Western Interior Seaway, extended southeast from the Arctic Ocean to the Gulf of Mexico, and westward to the Gulf of California. As the waters of this sea moved in and out, coastal plains, beaches and marshy areas were alternately formed, eroded and formed again. This resulted in some places where sandstone is 100 -150 feet thick and others where it is non-existent. Near Colorado National Monument, the yellowish sandstone ledges of the Dakota Formation remind us of a long ago ocean moving over this now near-desert, on the edge of the mountains…quite a curious leap for the mind to make.

The rock and soils upon which we walk today are the beginnings of another new layer of rock, one whose story is still being composed. It will contain bits and pieces of all the rocks described here, fragments of the rocks before you. If you wonder what this region will look like in the future, stick around for a million more years and find out!

The Rocks Before You

White to Black and In Between: Colors in the Rock

Red rock country: it has been written about many times. Its beauties have been the backdrop to, the inspiration for — and in some cases, the best part of — innumerable movies, television shows, paintings, photographs, weavings, ceramics, even calendars. Tourists from all over the world travel to see the colorful southwestern landscape. What makes the colors in the rocks that make this landscape so striking?

Quartz

First, rocks are made up of aggregates of minerals that are strongly bonded together. Minerals are naturally-occurring substances that have distinct physical and chemical properties. Quartz, for instance, is a compound of silicon and oxygen, or silica. Because quartz forms under many different conditions, not only does it have a range of crystal forms, but traces of other elements, or impurities, can also occur in it. As a result, numerous variations of it may be found. Pure quartz is clear and colorless (rock crystal). With manganese or iron added, quartz may turn purple (amethyst) or pink (rose quartz). With a higher percentage of water in it, or if fractured, quartz takes on a milky, opaque color. Igneous, sedimentary, and metamorphic rocks may all contain quartz. At Colorado National Monument, it forms both clear or whitish sand grains in sandstone, granite, and gneiss.

Feldspar

Not only does the mineral feldspar make up much of the Earth's crust, but it gives color to many rocks at Colorado National Monument as well. It is an aluminum silicate mineral that contains potassium, calcium or sodium. White and pink grains in Precambrian granites, and white to pink bands found in Precambrian gneiss come from feldspars. Thus, only a small amount of a mineral may make a major difference in the texture and color of a rock.

Iron Oxide

Several other minerals influence the colors in the rocks at Colorado National Monument. When the element, iron, bonds with oxygen, it forms the compound iron oxide, or hematite. Better known as rust, iron oxide can saturate the cement between the sand grains, creating varied reds, oranges, and browns in the Wingate and Entrada Sandstones. The deep red of the Chinle and the Kayenta Formations results from concentrations of one-half to one percent of this mineral. Iron oxide, in the form of limonite, gives a yellowish color to clays and Dakota Sandstone. Concentrations of iron also distinguish mica minerals found in granite and gneiss of Precambrian rock. While those with no iron content are white mica (muscovite), black mica (biotite) with its high iron content gives the dark color to the basement rock of the Colorado National Monument's canyons.

Morrison Formation

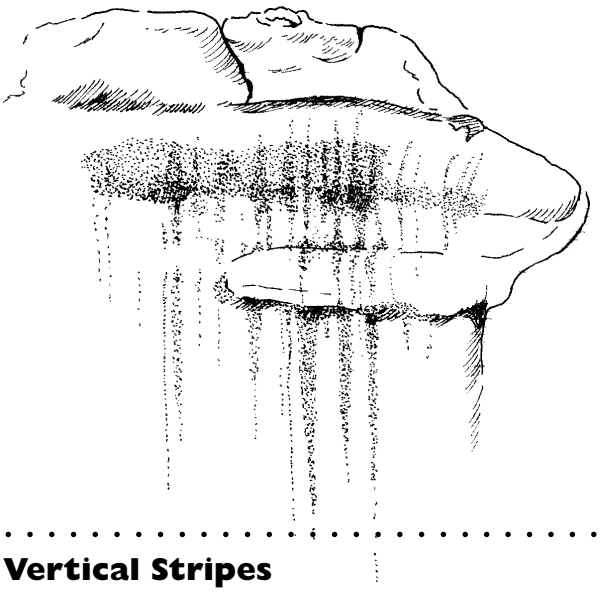
The Morrison Formation is recognized by its colorful rock layers. Its mud and siltstones are made up of tiny clay minerals. Compounds of silica, oxygen, and aluminum clays color the rocks with gray to brown to green to white. Across the Grand Valley, the deeply furrowed slopes of Mancos Shale get their gray color from clay minerals. Volcanic ash also contributes white to gray color in Morrison deposits.

The Rocks Before You

Calcite

Calcite is another mineral that brings color to rocks. A combination of calcium, carbon, and oxygen, calcite forms patches of white that can make a powdery crust on some rocks. Often found on the surface of sandstone, this soft coating can be broken apart with a fingernail.

As you look down from the rim of Fruita, Red, Ute, Monument, or No Thoroughfare Canyons, many of the sandstone cliffs have stripes or a sheen of black or brown. What causes them? How are they made?



Vertical Stripes

Geologists distinguish between the vertical stripes, reminiscent of zebra markings on the canyon walls, and the broad surfaces tinted brown or black, seemingly "varnished" by time. The stripes begin at the top of a cliff face and seem to fade out near the bottom. They look as if an elf poured paint over the edges of the canyon. In fact, they are mixes of algae, fungi, lichen, and bacteria growing on the rock. Rainwater flowing over the cliffs in storms appears to play a part in creating the stripes, both by carrying the organisms onto the rock and by bringing them moisture. Just as cryptobiotic soil crust swells and brightens after rains, so do the stripes. As they age, the stripes also become darker. Look carefully and see if you can locate one of these vertical stripes on a canyon wall. Is it new and light-colored, or is it older and blacker? Can you spot the place where the stripe begins?

Desert Varnish

Stains of brown, purple, and black that stretch across large rock surfaces are what geologists call desert varnish. They create a sheen that resembles shellac that has been painted across a cliff face. Desert varnish is comprised of 70% clay and its color is influenced by manganese and iron oxides. Varnishes high in manganese are black; varnishes low in manganese and high in iron are red or orange; varnishes having equal amounts of manganese and iron are brown. In general, the older the varnish the darker the color. Hard sandstone surfaces have more varnish on them than softer and easily eroded ones, and areas with high exposure to the sun appear to have darker stains.

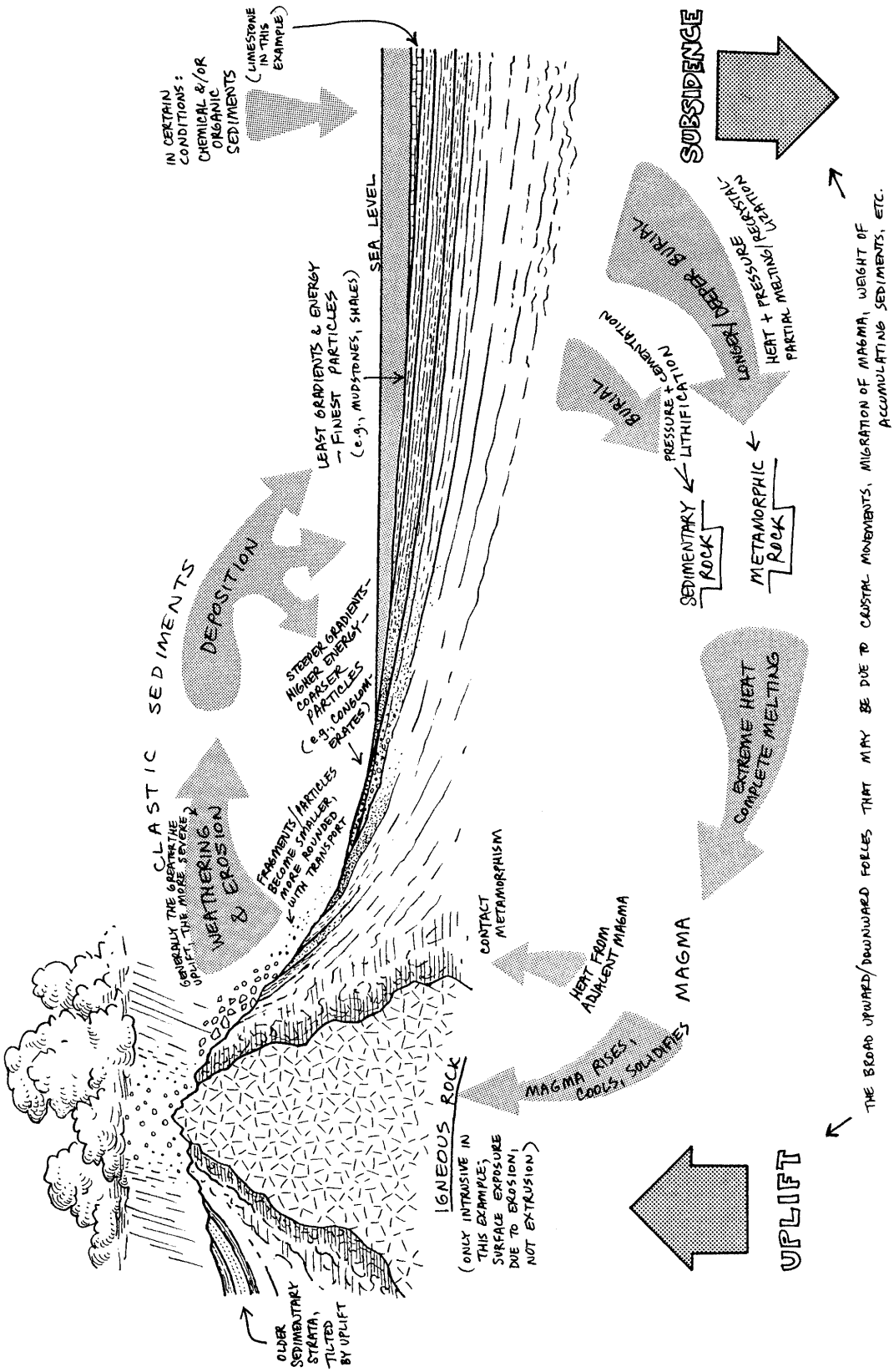
There are several theories explaining how desert varnish is created. Both propose that the manganese and iron come from outside sources such as windblown dust or rain water containing trace amounts of these elements. Where the theories differ is in the way the materials are cemented to the rock surface. One theory postulates that rainwater mixes with the clay on the rock surface. The water combines with the manganese and iron in a chemical reaction to create oxides which bond to the rock surface. In the second theory, bacteria is necessary for the creation of the desert varnish. The bacteria grow on the rock surfaces and are able to take manganese out of the environment and oxidize it, creating the varnish. These bacteria seem to thrive in the desert ecosystem.

Desert varnish is probably formed by a combination of the above factors. Regardless of the origin, desert varnish highlights and enhances the colors of many cliffs throughout Colorado National Monument.

Three Types of Rocks:
The True Origins of Rock and Roll

ACTIVITY PAGE

A Rock Cycle Sampler



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ACTIVITY PAGE

Age Level

4th through 8th grades. The lower grades will need more time and guidance to get through the activity.

Purpose of the Activity

"Three Types of Rocks" is a useful introduction to, or review of, igneous, sedimentary, and metamorphic rocks. By using clay to represent rocks, students explore the processes of eruption, intrusion, erosion, sedimentation, compaction, cementation, metamorphism, and subduction. This three-part activity gives students a hands-on, close-up experience with a basic geologic premise: the "rock cycle".

Amount of Time Required

45 - 60 minutes. The activity goes fast; the discussion of what happens will vary in length with age and curriculum.

Best Location

This activity may be done in the field or in the classroom. Suggested sites at Colorado National Monument are Saddlehorn or Devils Kitchen Picnic Areas, Devils Kitchen Trail, or the Old Gordon Trail. Choose an area with plenty of small rocks nearby for students to pick up and observe. In the school setting, desks, lawn, playground, even pavement may be used for this activity. Wherever it is done, be sure to remind students to keep track of little bits of their clay. Plan a clean-up brigade before leaving the area or the room.

Materials Needed

- ☐ Play-Doh™ or another soft clay. Each student will need two handfuls of **two** different colors of clay. The Play-Doh™ Party Pak works well in this situation, because it contains numerous small jars of colored clay. If you prefer to make your own clay, or have access to other brands, they will work just as well, so long as a variety of different colors is available.
- ☐ 8 1/2" x 11" pieces of tin foil, plastic wrap, or waxed paper for each student to use as a working surface.
- ☐ Tables or other flat areas on which to work with clay.
- ☐ Trash bag for cleaning up of tiny bits of clay that escape.
- ☐ **Optional**: Specimens of sedimentary, metamorphic, and igneous rocks to share with the class. If you are doing this activity along the trail, take advantage of textures, shapes, and colors of the surrounding rocks.

Three Types of Rocks:
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Background Information

This activity helps students to learn about three basic rock types that are studied by geologists, and seen at Colorado National Monument. In "Three Types of Rock", the origins of "*rock*" are explored as students "*roll*" handfuls of clay into representations of igneous, sedimentary, and metamorphic rock. With the clay, they enact ways that rocks are formed. The teacher describes the processes in detail. A final option is for children to look at real rocks around them, to classify into one of the three categories. Accompanying this activity with the song, "Rock Around the Clock", helps to set a rollicking mood. Educational content standards in science are met by this activity.

What is the Rock Cycle?

Just as there is a water cycle on the Earth, so there is a **rock cycle**. It begins with the creation of *igneous rocks* by volcanic activity, and the rising and cooling of magma from the mantle. Next, *weathering and erosion* act on these rocks, breaking them down into smaller and smaller pieces. Over time, the fragments are transported to new locations where *deposition* occurs. As layers of these particles build up atop one another, they *compact and cement (lithify) into sedimentary rocks*. The next phase of the rock cycle happens as the blankets of new sedimentary beds cover the older layers, causing them to slowly heat up. Eventually, the *pressure* and temperature may become great enough to cause the sedimentary rocks to *recrystallize* into *metamorphic rocks*. Finally, movements among the Earth's crustal plates can cause rocks to melt partially, or to be forced down through *subduction back into the mantle*. Once more within the deep, hot region of the Earth, the rocks return to where they came from, and the rock cycle begins again. Thus, continual upwelling from the mantle; eruption and formation into igneous rock; break down and erosion; sedimentation and deposition; lithification; build up of heat and pressure leading to recrystallization; and finally movement of the Earth's plates causing subduction are all parts of the never ending rock cycle. The construction of new rock thus begins in the roots of the old.

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What Are Weathering and Erosion?

Erosion and weathering are two important parts of the rock cycle. Both are part of the breakdown of rocks, the leveling of the land, the smoothing of high places matched with the filling of low places. As soon as rocks are exposed to the atmosphere, rain, cold, heat, and humidity begin to act on rocks, slowly wearing them away. Scientists call this **weathering**: physical and chemical processes that break down rocks in place, as they come in contact with the environment. After they have fractured and broken into smaller pieces, the forces of wind, running water, gravity, and glaciers can then move the fragments to new locations in the process known as **erosion**. Both weathering and erosion are vital parts of the creation of the Earth's landforms, and essential in revealing the stories found in the rocks. They may be dramatic and happen quickly, or they may occur very slowly. The composition of the rocks affects the pace at which they occur, with soft rock breaking down more quickly than hard rock. Fins, monoliths, and monuments are some of the dramatic features of Colorado National Monument that result from differing rates of weathering and erosion in adjacent layers of hard and soft rock.

"Three Types of Rock" gives students hands-on experience with processes of the rock cycle. We live upon the results of eruption, erosion, sedimentation, compaction, cementation, transformation, and subduction. Although the rock cycle is part of life in the world everyday, observing it first-hand is difficult. Volcanoes only erupt occasionally, and often at far distant locations. Watching mountains grow or the slow lithification of sediments is beyond the scope of most of our abilities. Luckily, at Colorado National Monument, not only is an enormous span of time revealed in the rock, but igneous, sedimentary, and metamorphic rocks may be also found. Along with them come uplifting, folding, faulting, and the remarkable sculpting by the forces of erosion. Because few other places in the United States have such unique exposures of rock, Colorado National Monument was set aside for preservation and protection in the National Park Service. No wonder that it offers such a marvelous place for a geology field trip!

Thus, even though "Three Types of Rocks" is a good classroom project, it can be a very successful component of a hike. Working with clay is an excellent tool for refocusing the group after lunch, or for quieting the group down under the shade of tree. In addition, it complements both the "Erosion Hike" and the "Stratigraphy Hike", and provides a good introduction to the "Make a Stratigraphic Column" activity.

Three Types of Rocks:
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How to Do the Activity

Preparations

Before you begin, review information about the layers of the Earth, about igneous, sedimentary, and metamorphic rocks, and the rock cycle.

1 Practice doing this activity beforehand to be comfortable with the clay, and familiar with what happens.

2 Any type of dough or clay that is easy to work with may be used to make the different kinds of rock. The key is that the clay needs to be brightly colored for the students to see clearly the processes described. For this reason, the "Play-Doh™" product works well. You can divide the small tubs of Play-Doh™ in half to distribute among the group. If you send a letter home ahead of time, you may find that many families have this product at home and will donate it to the class.

If you make your own dough, figure that each student will need two large handfuls or a total of 1/3 to 1/2 cup of dough per person. Remember also that each student needs to have two different colors of dough for this activity. A parent, student aide, or the class itself can be enlisted to do this part of the project.

3 Gather interesting specimens of rock to share with the class. Whether you collect rocks outside, or borrow rocks from someone's collection, be sure that you can identify if they are igneous, sedimentary, or metamorphic in origin.

The Day of the Activity

1 Prepare two handfuls of clay for each student. These may be set out on the desk or table just before the activity, or stored in plastic wrap until the appropriate time on the hike has been found.

2 Pass out one letter-size piece of foil or wax paper to each student. This will be used to help to enact compression and metamorphism. It will also aid in clean-up.

3 The class may benefit by seeing a picture of the Earth on the chalkboard or a piece of paper. Draw a large circle to represent Planet Earth. Just inside that circle, make a second slightly smaller circle. In between the two is the crust. In the center of the planet, make a small circle for the core. The large area in between is the mantle.

4 In addition, a sketch of the rock cycle is a useful reference. Be sure to show its different stages, beginning with igneous rock (both extrusive and intrusive), and continuing on through erosion; deposition; compaction; cementation; lithification into sedimentary rock; heat and pressure leading to metamorphism; and subduction returning rocks to the mantle. This, too, may be recorded on the chalkboard or on a hand-out.

Three Types of Rocks:
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Set Some Rules

Two Warnings If You Are on a Hike

Warning #1): If you plan to use this activity at Colorado National Monument, remind students that all rocks, even the tiniest, are protected by law, and must remain at Colorado National Monument. Collecting plants, animals, reptiles, insects – and even rocks – is strictly forbidden in national parks and monuments. Everything in these special places is to be protected and preserved into the future, so that others will be able to discover and enjoy them as well. However, students are welcome to look at and to share any especially interesting rocks with the group. Afterwards, the rocks *must* be returned to where they were found, so that they may continue on their journey as part of the rock cycle of the Earth.

Warning #2): If students are going to be picking up rocks, it is important that the teacher explain that rocks are shelters for a wide range of desert dwellers. Ants, beetles, spiders, scorpions, centipedes, lizards, and snakes all make their homes in and under rocks. Removing a rock can not only destroy the shelter of a creature, but it can result in the very real dangers of desiccation and predation. In addition, some of those creatures protect their territory with quite a dangerous bite or sting. **Look carefully around a rock before lifting it up. Tip it *towards you* slowly to examine who or what is underneath before picking it up. If something is under it, replace the rock *very gently* in *exactly the same position* as you found it.**

Step-by-Step Instructions

Step One: Pass Out the Clay and Paper.

Two balls of clay and one wax paper or foil sheet should go to each person. The clay should be two different colors.

Step Two: Set Some Rules for the Group.

These include:

1 Listen carefully to directions to have the right outcome in this activity.

2 Handle the clay carefully. Avoid getting the dough on the floor, carpet, or ground. Not only it is no fun to have lots of little bits of it to clean up later, but also it can be hard to get out of carpets. You do not want to leave any of it out in nature as it is littering, and no animals will get near it.

3 To show that you have completed each step of the activity, you should hold up what you have done in the air.

Step Three: Set the Scene.

Set the scene by asking students to observe the different sizes, shapes, and colors of rocks around them. Reflect on the ways rocks are used in our daily lives. Buildings, streets, roads, gardens, sculptures, metals, coal, granite or marble in fireplaces and counter tops, even pigments in paint, all derive from rocks. Soil, in which we grow food for people and animals, can also be added to that list. When you think about it, a great deal of our lives is connected to rocks. Indoors, ask students to identify things in the school setting that are made from rock, including: cement, bricks, stone walls, nails, chalk, glass, copper wire for electricity, as well as other classroom materials.

Step Four: Getting Started.

Ask students to pick up one of the balls of clay and roll it around in their hands. Introduce the activity by explaining that the class will be investigating three types of rocks found on the Earth. They will explore the diverse origins of these *rocks* by *rolling* and working with clay to create them.

Definition of Rock

Next, the teacher should ask if students know what rocks are, and where they come from. The variety of answers may be interesting to record on the chalkboard. One of the simplest definitions of rocks is: **Rocks are *consolidated* mixtures of minerals that occur naturally.** The different mineral grains are held together very strongly through chemical and physical bonds. Over time, and exposure to the elements, rocks may decay and break down into soil, or the fragments may be carried away by wind and water, eventually to become lithified into new rock.

Rocks form in three ways. The first is from hot, molten material from the Earth's mantle rising up to create **igneous** rock. The second way is from loose sediments compacting and cementing together into **sedimentary** rock. The third way that rocks form occurs when heat, pressure, or both act on igneous or sedimentary rock to change or recrystallize them into **metamorphic** rock.

Step Five: Introduce Igneous Rocks.

Use the drawing of Planet Earth for reference here. Go over the parts of the Earth, and explain that igneous rock is formed when molten material from within the mantle rises up into the crust. When this magma pours out onto the Earth's surface from a volcano, it is known as lava. Geologists call this process **extrusion**. You may want to draw a picture of a volcano on the chalkboard to help illustrate this process.

If the molten material remains underground, it is known as **intrusion**. Under the Earth's crust, this molten material may force its way into the older rocks. If a large enough mass rises up, it may cause a bulge in the crust (an uplift) or a mountain range to form.

Again, a sketch on the chalkboard may help students to grasp this idea.

Both extrusive and intrusive igneous rock may be seen all over the world. Hawaii and Iceland are both examples of places where volcanoes are active. Mount St. Helens in Washington State and Mount Pinatubo in the Philippine Islands are recently active volcanoes that have had huge impacts on their surrounding communities, and even the world's atmosphere. Closer to home, ancient lava flows cap Grand Mesa. The Uncompahgre Uplift, of which Colorado National Monument is a part, and the Yosemite Valley in Yosemite National Park in California, contain ancient intrusive rocks. Granite and pegmatite are the two forms of igneous rock found at Colorado National Monument.

Step Six: Rock and Roll.

In this section, it is helpful for the teacher to demonstrate what to do with the clay each step of the way. Having students hold up their clay each time they have completed the required action will give the instructor an idea of how everyone is progressing. It will also aid in showing who may need help. Because each person will have a unique result, students also enjoy seeing how others' clay looks.

- Instruct students to choose one of their balls of clay. They should roll it in their hands until it is soft. This should take no more than 30 seconds.
- Next, they should break the ball in half, and exchange one-half with a neighbor *who has a different color of clay*. The outcome should be that everyone now has two small balls of clay, and one larger ball of clay, each of which is a different color.
- When the exchange is complete, the class should flatten one of the two small balls by pressing down on it with the palm of their hands. The clay should be thin, but not so thin as to see through it, or have holes in it. This flat piece will be the Earth's crust in the simulation of the formation of igneous rock.
- Set aside the "crust" briefly, and pick up the second small ball of clay. Roll it around in the hands until it is a soft round ball. Carefully lay the flattened "crust" on top of it. The edges can drape over it without any problem.
- Ask students to hold up the ball of clay with one hand and lightly stabilize the flat piece on top with the other. Then, they should push the ball of clay up *strongly* into the flat piece. Ask them to watch carefully to see what happens to the "Earth's crust" when pressure comes from below. This action represents what happens as magma rises from the mantle into the Earth's crust. Where it finds an opening, or a thin, weak place in the crust, it can come out onto the land.
- When everyone is done, ask how many students had the ball of clay break through or into the flat top layer. This exemplifies the process of extrusion. The ball of clay acted like magma, and pushed through the crust out onto the Earth's surface. Pick out one or two examples of clay to show to the whole class.
- The balls of clay that did not break through the top layer demonstrate the process of intrusion. The crust may have risen or domed up, but the magma ball did not come through. This happens in places where the crust is very thick, or the magma cools and hardens before it reaches the surface.
- Depending on what the students observed, and depending on your time, you may want to repeat this experiment.

Step Seven: Introduce Sedimentary Rocks.

This segment of the activity focuses on a second type of rock known as **sedimentary rock**. Its origin is in igneous rock that slowly breaks down from the action of wind, water, freezing, thawing, and heat. Over time, what was once a large dome of granite, or a slope of basalt, fractures into smaller and smaller pieces. Eventually, these fragments, most no bigger than a grain of sand, are carried away in a river, blown away by the wind, or "roll" to a new location. Places where accumulations of sediment occur include the ocean floor, shore and coast lines, reefs, rivers, deltas, lakes, ponds, etc. In these sites, particles may be buried under yet more sediment. The weight of new layers atop the old squeezes out water, and compresses the grains. Compacted, and under increasing pressure and temperature, some minerals solidify together, while others dissolve to flow between the grains. Still others, like quartz, remain unchanged. Slowly, fragments of old rock cement together as minerals solidify into new rocks from old sediments. This, then, is a simple definition of sedimentary rock: a new generation of rocks formed from the decay, erosion, and re-deposition of older rocks.

Step Eight: The Break Down.

In this step, the children are simulating the actions of weathering, erosion, deposition, compaction, and lithification. In the center of the foil or wax sheet, students should break up their "igneous rock" into small pieces. This should include both small balls of clay. (The one that has not yet been used still should not be touched.) When the clay is broken into fragments, pile up the pieces in the center of the sheet. Next, fold the sheet over the top of the pile of clay. This should create a "foil sandwich," with the foil as the "bread" on the outside, and the clay as the "filling" on the inside. Remind the class to do the break down carefully to minimize clean-up later.

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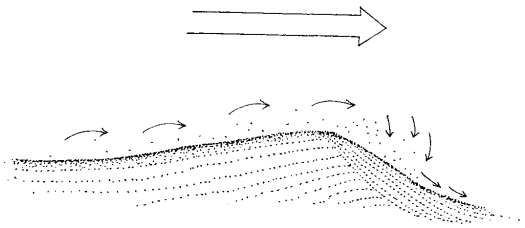
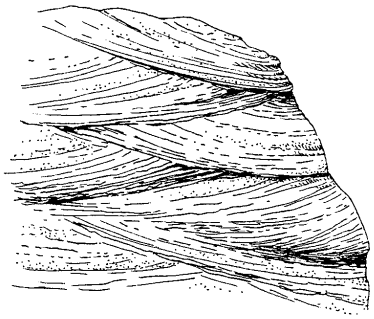
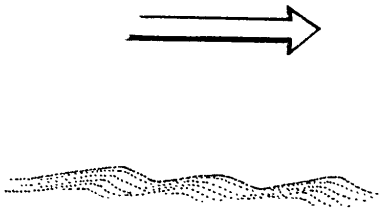
2 KINDS OF COMMONLY-SEEN SEDIMENTARY STRUCTURES

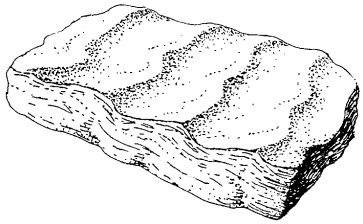




EOLIAN CROSSBEDS

at top, "active" sand dune showing wind direction (large arrow) and sloping sand layers formed as grains roll & bounce (small arrows) up upwind slope, drop to form steeper downwind slope / below, crossbedded sandstone, showing multiple sets of beds at varying angles from shifting winds





RIPPLE MARKS

water current (arrow, top) may form ripples similar in shape to sand dunes but on a smaller scale; symmetrical ripples can also form (such as on a shoreline with ebbing/flowing wavelets)

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Compaction and Lithification

When this is complete, ask students to place the palm of **one** hand on the foil, and press down **lightly** to flatten the pile of clay. They should not press hard, or for a long time. Merely flattening the clay is all that is needed.

Erosion and Weathering Simulation

Step Nine: The Uncovering.

The group should carefully open up their foil packets and inspect what is inside. What happened to the clay? Their observations should include that the tiny pieces of clay are all squished together (compacted), thereby forming a new rock from the pieces of old rock (lithification).

Ask everyone to hold up their new rocks so the group can see the unique mix of "rock" material, color, shape, thickness and texture that each person has. In nature, the variety of particle shapes; the minerals composing them; the way that they were compacted; and the amount of pressure applied, act together to create different types of sedimentary rocks. For example, sandstone (grainy) is distinct from clay (fine particles), breccia (large, angular fragments), or conglomerate (round pebbles).

Checking the Results

Step Ten: Testing the Sedimentary Rock.

1 Can the students break their new rock apart into some of the original pieces of clay? The students' answer should be yes, but with some effort. It is important to note that nothing has actually changed within the rock, merely individual pieces have been compressed and stuck together.

2 A second test is to break the new rocks in half and look inside. The students should see loosely consolidated particles of colored clay, along with some areas of open space. This is typical of sedimentary rocks, such as sandstones, where particles may touch one another but still have some space in between. As layers and layers of rock build up on top of the first sediments, they compress them, but do not change the original pieces. Silica, calcite and other minerals can flow into the spaces and act as cement that ultimately holds the individual pieces together, forming a new type of rock.

Put aside these "sedimentary" rocks to save for the next part of the activity.

Three Types of Rocks:
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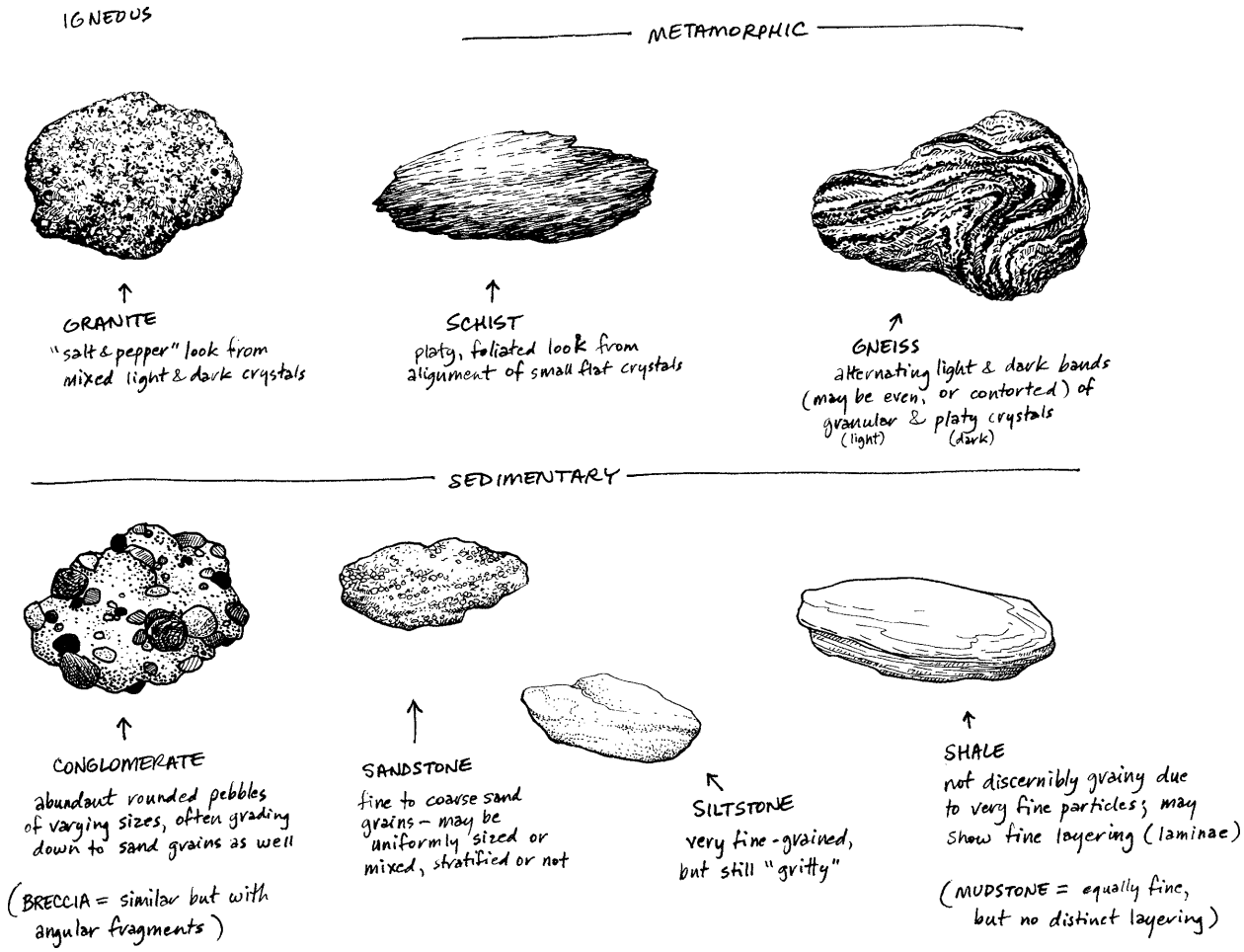

Metamorphic Rocks

Step Eleven: Introduce Metamorphic Rocks.

Metamorphic rock is formed when pre-existing igneous, sedimentary, or metamorphic rock is exposed to great pressure or high temperature. Under these conditions, the rock may be changed or "transformed" into an entirely new type of rock. Metamorphism occurs in several ways. First, when lava from volcanoes, or from intrusions of the mantle, rises up into the crust, rocks in the vicinity are heated to such high temperatures that minerals re-form into new types of rock. Secondly, during times of mountain-building, folding, or movement of the Earth's crust, rocks may be squeezed and subjected to such high pressure that they recrystallize into new rocks. Examples of metamorphic rock are quartzite deriving from sandstone, and marble coming from limestone and slate forming from shale. Metamorphic rock itself can become hot enough that it can turn to molten rock, or magma. This type of partial melting of metamorphic rock has been found at Colorado National Monument.

Step Twelve: Rock and Roll, Part Two.

For this final segment, students use the handful of clay that has not yet been used. They should "roll" this piece in their hands to soften it. Then they should lightly flatten it into a small pancake, and place it on one side of the foil or wax paper. Next, they should place the "sedimentary rock" made in Steps Eight and Nine on top of it. This action simulates the deposition of layers one upon the other that build up in depth, weight, and pressure on the layers below. Cover both the old and the new clay with the remaining portion of the foil or wax paper.

Step Thirteen: Heavy Pressure.

In this segment, it is important that students listen carefully to the directions to obtain the best outcome. First, ask students to take off one shoe, and put it out of the way nearby. Secondly, students should place the foil packet on the floor, or a flat piece of ground where no rocks will protrude into the clay. Thirdly, students should stand up, and step down hard, with full weight, onto the clay packet. *NOTE: Do not grind or twist feet on the clay, as foil rips easily, ruining the effect. For this reason, stocking feet are also recommended: the soles of shoes can rip through the clay.*

This action represents how the weight of layers of rock atop one another can build up enough pressure and heat to effect change in rocks. In our case, the weight of the student symbolizes the weight of sediments upon each other. Stepping down heavily denotes the pressure those sediments create, thereby compacting and compressing the rock, and causing it to transform and recrystallize into a new rock. This process is known as metamorphism.

Ask the students to open up their packets very gently and carefully. The clay, this time, should be a swirl of all three colors. They should be so closely blended that they cannot be separated from one another. How does the new, "changed rock" look? How is it different from the earlier sedimentary rock?

A test for metamorphic rock: Can you separate the two layers of clay from one another with your hands? What does this new rock look like on the inside when broken open? Which rock appears to have more air spaces within it? What causes metamorphic "rock" to be so different from sedimentary rock? The response that you want is that with greater pressure comes greater change to the rock.

Step Fourteen: Clean up.

Clean up the classroom or the area where the students did the activity. Especially if you are outside, you want to make sure that no traces of the clay are left on the ground. Plan a cleanup brigade to leave the area spotless.

A final (optional) observation segment is very effective. Look at several examples of rocks from a rock collection, to see if the class can decide if they are igneous, sedimentary, or metamorphic. If you are at Colorado National Monument, pick up a rock that is on the ground near you (see earlier warning about picking up rocks), or get up close to a large boulder. Feel the texture of the rock. Can the class figure out what it is composed of? Review the definitions of the three rock types if students seem unsure.

Depending on where you are at Colorado National Monument, the majority of rocks should be sedimentary or metamorphic. However, you may want to note that many of the grains of sand composing the sedimentary rock could have had their origins with magma, or igneous rock, from long ago volcanoes, sea-floor spreading, or mountain building. Quartz, or silica, is a primary element in sand, and often derives from mantle rock.

Conclusion

Using simple materials like clay, students are able to simulate key elements in the formation of rock and in the rock cycle: extrusion, intrusion, erosion, weathering, sedimentation, and metamorphism. After this activity, the class should have a much better awareness of and appreciation for the rocks around them.

Three Types of Rocks:
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Extensions

For younger students, this activity can be divided into several sections and spread over several days. Another option is to do only one part of the activity, highlighting how one kind of rock is formed. Numerous children's books are available about rocks, minerals, and rock hunting. You may want to include exploration of those books, either as a group or as individuals. Your local library should be a good resource.

For older students, a drawing or writing component can be added to this activity. Students can make a record of what happens in each segment either by drawing or writing. To encourage the use of the scientific method of observing and recording, students can be given a homework assignment to write up their "laboratory" experience with making rocks, and put it in the structure that scientists use when they conduct experiments. The structure includes the following:

~ Summary of what took place.

~ Hypothesis of what student expects to happen with the experiment.

~ List of materials used.

~ Step-by-step description of what was done with the materials.

~ Observations of what took place when actions were taken.

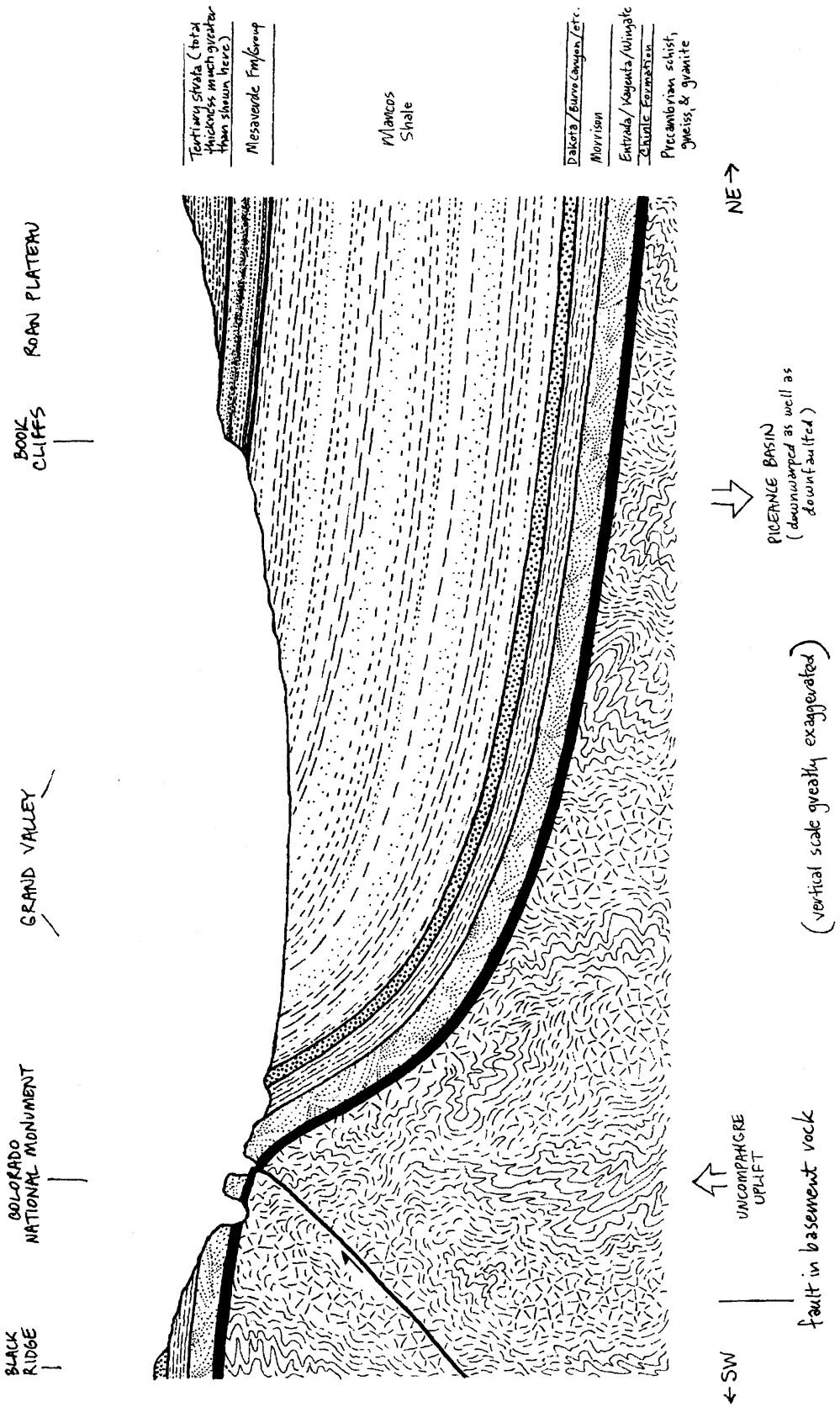
Other options for students are:

1 Visit the Museum of Western Colorado for a tour of their rock collection.

2 Take a field trip to a site where rocks can actually be collected. Ask a local geologist for suggestions of interesting geologic sites in the region. Remember, however, that rock collecting must be done only where it is permitted. Do not attempt it at Colorado National Monument, which is federally protected land. Be sure you have permission of the owner to collect on private property.

Make a Stratigraphic Column
of Colorado National Monument

ACTIVITY PAGE



Make a Stratigraphic Column
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ACTIVITY PAGE

Age Level

4th through 8th grades.

Purpose of the Activity

Through this activity, children experience a hands-on, close-up look into the workings of geology. First, they learn about a stratigraphic column, a diagram of the sequence of rock layers of a given area. Secondly, when they create their own stratigraphic column of the rocks found at Colorado National Monument, students gain knowledge about the features of individual rock layers, including composition, depth, color, fossil life, age, texture, and hardness. Thirdly, basic tenants of geology, such as the "Law of Original Horizontality" and the "Law of Superposition" are incorporated into the activity. While these are complex sounding terms, the concepts, that rocks are laid down in horizontal layers, with the oldest at the bottom, and youngest at the top, are easy for children to grasp with the column.

Making a stratigraphic column is also good preparation for a field trip to Colorado National Monument. Students are better able to find, identify, and appreciate actual rock formations after they have made the column. Alternatively, this activity makes a useful follow-up to a geologic exploration of Colorado National Monument. Because it is against the law to collect rocks (or anything else, for that matter) in a national park, the column is a good way for students to make and keep a tangible record of their experience.

Amount of Time Required

Three hours are needed for this activity: one hour for preparation and two hours for the column itself. Some extra time may be required for clean-up and labeling of formations. The column project can be completed either in one class session or in several.

Preparation time, estimated to be one hour, is for locating and gathering materials. The results are well worth the effort. The teacher's time can be reduced by sending a note home requesting parental assistance with "unearthing" materials. In addition, the more organized you are in setting up, the more quickly and smoothly the activity goes.

Activity time should be about two hours for 4th through 6th graders. Times will vary depending on how artistic or meticulous a given class is. 7th and 8th graders may need less time. The activity is easily done in stages. It may also be finished at home.

Make a Stratigraphic Column
of Colorado National Monument

ACTIVITY PAGE

Materials Needed

The list of ingredients for the stratigraphic column is long because nine different rock formations are created by the class. Since students really enjoy making the columns, and learn a lot in the process, it is more than worthwhile to spend the time gathering materials. Enlist parental help by sending home a note about the project several weeks in advance. Ask for donations and assistance from families, and getting the materials will be much easier.

Amounts given for this project are estimated for a class of 25. If your class is different in size, change the amounts proportionally. If you cannot come up with one or more of these elements, *feel free to improvise* with what you have on hand.

Ingredient List for Stratigraphic Columns

- ☐ 25 pieces of 8 1/2 x 11 inch scratchboard, mat board, or thick cardboard. (Due to the weight of the sands and glue, a sturdy base, such as mat board, is needed. The size and color may vary: you just want the sands to show up against the background. Picture framing stores and art suppliers often have scraps of mat board that they will donate for this project.)
- ☐ 3 packages of 3 ounce paper cups. (For holding sand.)
- ☐ 2 packages of toothpicks. (For flattening and smoothing glue, and for dinosaur bones.)
- ☐ 25 plastic spoons. (For sprinkling sand and other materials.)
- ☐ School glue—one bottle per student. (Easy access to glue speeds up the activity.)
- ☐ 1/4 lb. wood shavings. (The shavings should be natural colored. They can be purchased in the pet department of stores, or gathered from a wood worker.)
- ☐ 1/2 lb. of tiny shells. (These can be the kind for craft use, or leftover from other projects.)
- ☐ 1/4 lb. of pea gravel. (The kind from fish tanks or foot paths.)
- ☐ 1 container of sparkles.
- ☐ 1/4 lb. of peat moss.
- ☐ 4 - 6 briquettes of coal crushed into small, gravel-sized pieces.
- ☐ Plenty of newspaper. (For covering work areas and the floor.)
- ☐ Copies of the "Stratigraphic Column of Colorado National Monument" for each student.
- ☐ Pencils, markers, and rulers. (For marking off and labeling different rock strata.)
- ☐ Sand. (10 - 12 cups *each* of beige, pink, gray, white, red-orange, purple, and black sand are needed to simulate colors of the different rock formations. Some sand can be dug up locally. Another option is purchasing Art Sands™, pre-colored sands, which are found at art supply stores.) *See note.*
- ☐ Ziplock™ plastic bags and a trowel or old spoon. (For digging up sand.)

Access to a sink is helpful.

Make a Stratigraphic Column
of Colorado National Monument

ACTIVITY PAGE

A Note About Sand

You will need a number of different colors of sand to simulate the rock layers in the "Stratigraphic Column". To save the expense of buying sand, and to make the project more authentic, beige, pink, gray, purple, and white colored sands can be collected locally for this project. Approximately 10 - 12 cups of each color are recommended. The source of the sand is not as important as the range of colors. Use a trowel or old spoon to dig up sand from any of the sites listed below. Ziplock™ plastic bags work well to hold the sand. Do not take sand from Colorado National Monument itself, and get permission if you plan to dig on private property. When digging sand, be sure to park off-road, and watch out for car and bicycle traffic.

Best Location

Where to Find Sand Locally

- **Along Monument Road** out of Grand Junction, you will enter into an area where the gray, green, purple, pink and white rocks of the Morrison Formation come right down to the road. You can dig up sands in this area.
- **Along the Broadway/Redlands Road**, in the vicinity of the Lower Monument Canyon Parking Lot turn-off, and approximately three miles east of the West (Fruita) Entrance Station, is another area where the colorful bands of the Morrison Formation may be found. Again, gray, green, purple, pink and white sands can be found here.
- **By the Fruita Bridge** over the Colorado River, or at other bridges or boat launches along the river, yellow-brown beach type sand can be found.
- **Sandboxes** can also be raided for beige or tan-colored sand.

Art Sands™

Art Sands™, like those used in sand painting, are available in many discount and artist's supply stores. These can be utilized to make the colorful layers such as the Entrada (white and yellow), Wingate (orange), Kayenta (dark red), and Precambrian rock (black). If you explain that you need the sands for a school geology project, many suppliers will donate or give discounts on your purchase. Parents may have them also.

Make a Stratigraphic Column
of Colorado National Monument

ACTIVITY PAGE

Background Information

The Classroom

This activity is intended to increase students' awareness of and appreciation for the diversity of rocks contained within Colorado National Monument and the region. One of the reasons that the monument was created was because of the remarkable span of time and rock that is exposed there. In few places other than the Grand Canyon and Dinosaur National Monument can such a time span be observed in the rocks. Making a map of the rock layers of the monument gives students a hands-on opportunity to learn about the different layers of rocks and how they were formed. In addition, a stratigraphic column is fun to make and serves as a concrete reminder of a place visited. As a result, this activity makes an excellent follow-up to a field trip. Since no rocks can be collected on any National Park Service property, the Colorado National Monument stratigraphic column is a personal, artistic, and scientific way to make a record of a visit.

How Geologists Use Stratigraphic Columns

Geologists use stratigraphic columns as visual maps from which to learn more about a place. Just as road maps to help guide us from point A to point B on the surface of the Earth, these columns help geologists to keep track of the sequence of time spanned through the rocks. If a particular fossil is sought, or if a mineral is desired, these views of the arrangement of rock layers are useful to pinpoint the right area to look. Columns are also invaluable for comparing rocks found in different parts of the country and the world. When a road or shopping mall is projected to be built, geologists and engineers consult stratigraphic columns to determine that the rocks below will support development. Answers to such questions as: "Is an area prone to landslides in heavy rain?" or "Is water accessible at a certain depth?" may be found in stratigraphic columns. Last, but not least, these useful devices function as teaching tools in the study of geology. Basic concepts of geology, such as the "Law of Original Horizontality", the "Law of Superposition", and the concept of "Uniformitarianism", are exemplified in them.

Constructing stratigraphic columns of the rock formations in a given area is one aspect of the work of a geologist. The experience of constructing their own column of the stratigraphy of Colorado National Monument offers students the chance to learn what is involved in real-life geology. Content standards in geography and science are also met through this activity.

Make a Stratigraphic Column
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Definition of Stratigraphy

What is stratigraphy? Geology is the study of the Earth, and stratigraphy is a branch of that science. It focuses on rock formations, how they are related to one another, and how they are distinct. The characteristics of each formation, such as the fossils and minerals, and their arrangement within the rock, are of special interest. By investigating the composition and arrangement of rock layers, stratigraphers can begin to ascertain the dates when different environments existed on our planet.

Stratigraphic Column Defined

What is a stratigraphic column? It is a representation of the layers of rock as they rest one upon the other, from the deepest layers known up to the surface of the Earth. The Grand Canyon is an example of a stratigraphic column that has been exposed by nature. It is an ideal place to view the many layers of rock that compose our world. The canyons of Colorado National Monument are another place where layers of rock have become visible due to uplifting, faulting, and erosional forces. Because so many formations are exposed, geologists come here to observe and draw the rock layers into maps they call stratigraphic columns. Other terms for these maps are rock columns, rock sequences, and geologic columns.

How the Column Works

How does a stratigraphic column work? Geologists use stratigraphic columns to study the different rock layers for their unique character, including mineral composition, fossil life, texture, color, thickness, and hardness. Geologists learn to distinguish the layers, just the way a detective uses fingerprints to identify a person. Because the layers occur in a sequence that holds true across vast areas, geologists use stratigraphic columns to predict that if they are standing in white to yellow to salmon-colored rocks of the Entrada Formation, then the Navajo Formation should be below. Places such as at Colorado National Monument, where the Navajo Formation is actually missing in the rock sequence, are just as interesting – if not more so!

Because sedimentary rocks are created in flat, horizontal layers, and only later being folded, faulted, and eroded, stratigraphic columns help to keep track of the original order and organization for comparison with what actually exists. Finally, stratigraphic columns help geologists to estimate the age of rocks. The oldest rocks are always shown at the bottom of the column, with each rock layer above being younger than the previous layer. Stratigraphic columns are, thus, highly informative and useful geologic tools.

Make a Stratigraphic Column
of Colorado National Monument

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How to Do the Activity

Preparations

1 Recruit some parental assistance in gathering the materials. Much of what is needed is available in garages, art boxes, and storage bins at people's homes. A note home requesting supplies should bring you many of the supplies that you need. Use the services of a volunteer to dig up, or purchase, the remaining sand and fixings.

2 A sturdy base for the stratigraphic column is essential to its success. Regular paper will soak up the glue and become very flimsy under the weight of the sand. Use mat board, or another thick type paper for this activity.

3 Review the information about geology and rock formations in "The Rocks Before You" section of this chapter. Copy off the "Stratigraphic Column of Colorado National Monument" for each student to use for reference in this activity.

4 Enlist several parents or a teacher's aide to come assist you on the day of the activity. This will help speed preparations, assist students through the process, and ease clean up pressures.

5 On the day of the activity, allow 30 minutes for two people to set out the materials in advance of class. Each student will need the following supplies:

~ Newspaper (to cover the desk and floor below).

~ One piece of mat board.

~ Bottle of glue.

~ Pencil and ruler.

~ Plastic spoon and toothpick.

~ Copy of the "Stratigraphic Column of Colorado National Monument".

The rest of the materials can be shared by the group.

Setting Up the Classroom

6 If space allows, set the classroom up like a cafeteria, with groupings of sands, shells, gravel, shavings for each rock formation in different locations. This structure allows students to work more easily on their own: as they complete one layer, they can return excess materials to that station, clean up, and move on to the next formation. Setting out supplies in the same order as the "Stratigraphic Column of Colorado National Monument", beginning with the oldest rock and moving to the youngest rock, makes it easy for students to keep track of where they should be.

7 If time permits, pour sand into paper cups and arrange other supplies in advance. Remember that some materials will be used in more than one formation, so pay attention to amounts listed in the "recipe" below. If time runs short, set out cups and bags of sand for students to fill themselves.

Make a Stratigraphic Column
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Recipes for Rock Formations in the Stratigraphy Column

■ **Precambrian Rock** (Bottom layer of rock, and the thickest.)

~ One-quarter cup of black sand. (Art Sands™.)

~ One-quarter cup of pink sand. (Art Sands™ or Morrison sediments.)

~ Paper with large pinch of sparkles.

■ **Chinle Formation** (Slope-forming layer, atop the Precambrian.)

~ One-quarter cup of dark red sand, or red and gray mixed. (Art Sands™.)

~ Paper with a pinch of peat moss and a pinch of wood shavings.

■ **Wingate Sandstone** (Thick, cliff-forming layer, over the Chinle.)

~ One-third cup (total) of orange, red, beige sand mixed. (Art Sands™.)

~ Pinch of black sand.

■ **Kayenta Formation** (Thin, slope-forming rock, found above the Wingate.)

~ One-quarter cup of red or dark red sand. (Art Sands™, or use rest of Chinle sand.)

~ One-quarter cup of purple or gray sand. (Taken from Morrison sediments.)

~ Paper with pinch of wood shavings. (Or use up Chinle shavings.)

■ **Entrada Sandstone** (Cliff-forming formation, over the Kayenta.)

~ One-quarter cup of white sand. (Art Sands™ or river sand.)

~ One-quarter cup of orange sand—or orange and red mixed. (Art Sands™, or use rest of Wingate.)

■ **Wanakah Formation** (Thin, banded rock between the Entrada and Morrison.)

~ One-quarter cup of pink Morrison sediments, or red Art Sands™.

- **Morrison Formation** (Thick, colorful, banded rock formation, above the Wanakah.)

~ One-quarter cup of gray sand. (Morrison sediments.)

~ One-quarter cup of pink sand. (Morrison sediments.)

~ One-quarter cup of white or beige sand. (Art Sands™, river sand, or use up Entrada.)

~ Paper with large pinch of peat moss. (Use up Chinle, if some is left over.)

~ Paper with large pinch of wood shavings. (Use up Chinle, if some is left over.)

~ Several toothpicks broken into small pieces to represent dinosaur bones.

- **Burro Canyon Formation** (Found above the Morrison.)

~ One-quarter cup of grayish, or gray-greenish sand. (Morrison sediments.)

- **Dakota Sandstone** (Cliff-forming layer above the Burro Canyon.)

~ One-quarter cup of beige sand. (Sandbox or river sand.)

~ Paper with 5-8 shells.

~ Paper with several small chunks of charcoal.

Suggestion for Younger Students

A Suggestion for Younger Students: The teacher should plan to be the guide for this exercise, making a demonstration column alongside the students. Visual as well as oral explanations may be helpful for some classes. One option is to draw the stratigraphy column step-by-step on the chalkboard. Another is to set the class up like a cooking or home improvement show, where the instructor makes his or her own sample in front of the students. Extra parents can be put to use circulating in the room to assist with any problems that come up.

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Step-by-Step Instructions

1 Introduce the activity to the class by explaining what a stratigraphic column is and how it works. Ask students to think of situations where horizontal layers pile up from old to new. Common examples in the home are laundry baskets, stacks of pancakes, and garbage in trash cans. Examples from nature are: snow drifts (oldest snow on the bottom, freshest on top), and tree rings (oldest layers in center, youngest on outside). That the layers on top are younger than those underneath (or down below) is a fundamental tenant of geology: the Law of Superposition.

Perhaps the most dramatic and extensive example of layers piling up is found in the Earth's crust. The rock we live on originates from eroded particles of ancient rocks that have been compacted and cemented together. Geologists go to places with a lot of exposed rock to be able to look "inside" the Earth and learn about what happened in the past. The deeper we look in the crust, the older the rocks are. Colorado National Monument's deep canyons, steep cliffs, and unique erosional features make it an ideal place to study the span of geologic time. In preparation for a visit there, or as a follow-up afterwards, students will be creating their own stratigraphic column of area rock formations.

Review the Rock Column of Colorado National Monument

2 Review the "Stratigraphic Column of Colorado National Monument" hand-out with the class. Discuss the how each formation has its own unique features and composition. Explain how each layer of rock was created as a horizontal "bed" under a set of distinct environmental conditions. (Law of Original Horizontality.) This same process is going on today. Layers of soil and rock are breaking down into smaller and smaller pieces. These sediments are being washed down streams and rivers, and swept off the continents to pile up atop one another in oceans. Little by little they are solidifying into rock. Entirely new rock is also extruding onto the Earth's surface through volcanoes, and rifts in the crust. These processes are the very same ones that created the very oldest rocks on Planet Earth. (Uniformitarianism.) Thus, fundamental lessons of geology are revealed within the stratigraphic column.

Students Simulate Work a Geologist Does

3 Begin the activity by explaining that each class member will learn about the work that geologists do by creating their own stratigraphic column of Colorado National Monument. To simulate what geologists do in the field, students will glue different materials to a piece of mat board to create a map of the layers of rock seen at the monument. The supplies that they will need are set out on their desks and at stations within the classroom. The teacher should show the different stations from which to get supplies, and explain that there is enough sand and rock for each person and each formation.

Individual Artistry

4 Commence the artistry and the individuality. Each student can interpret the rock column in his or her own way. Remind them, however, that nine layers, some quite sizable, must fit on the mat board. Since students need room to label the formations, they should plan to leave space at one side or the other of the column for them. Refer them to their "Stratigraphic Column" hand-out to get an idea of how their final product might look. Students may find it beneficial to sketch an outline of their column onto the mat board before applying the glue and sand. The "Stratigraphic Column" hand-out is a useful guide if they need one. A ruler may be helpful in drawing boundary lines between the rock formations. When this is complete, students should proceed to collect materials for making Precambrian Rock, the oldest rock found in the monument.

Precambrian Rock

5 Precambrian rock makes up a significant part of Colorado National Monument. It is found underlying all the other rocks here, forming the floor, or "basement rock". Much of the Precambrian rock here is metamorphic in origin, meaning that it is composed of rocks that have been exposed to such pressure and heat that, over time, the original rocks have been transformed into different ones. The new rocks have been bent, folded, melted, and recrystallized, and curiously, eroded off to form a flat, smooth surface on which other rock layers have been deposited. The Precambrian rocks in the monument formed about 1.7 billion years ago. Because Precambrian rock represents the some of the oldest rock known, geologists study it for clues as to how the Earth might once have looked, and to understand about the geologic processes that created it. What happened to this rock, and what are the stories contained within it? These are questions to which answers are still being sought.

At Colorado National Monument, most of the Precambrian rock is metamorphic. It is composed of dark gray to black gneiss (pronounced "nice") intermingled with areas of white, pink, and black granite. Gneiss is a distinctively layered rock made up of the minerals quartz, biotite, and feldspar.

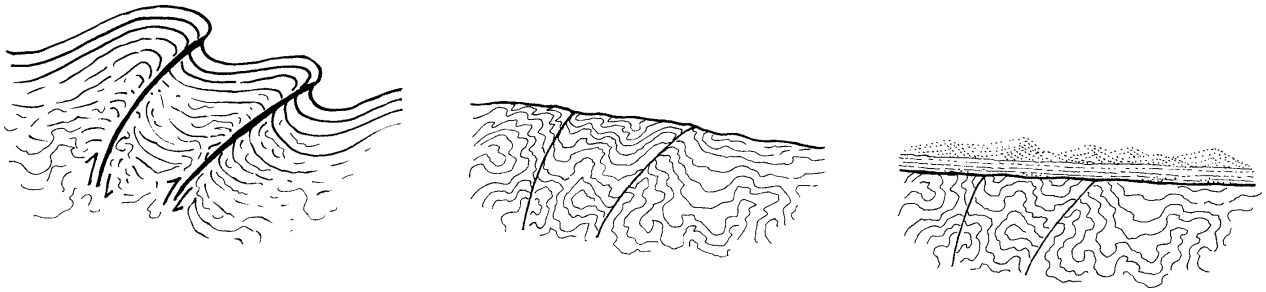
To make this rock: Spread a wide band of glue across the bottom two-thirds of the mat board. Use a toothpick or spoon to smooth it into a solid layer. Sprinkle black Art Sands™ evenly across the top of the glue, covering it entirely. When this is complete, use a toothpick to draw a series of wavy lines across the sand and glue. Make some of the lines thin and close together, and others wider and far apart. Imagine that you are trying to write while on a bumpy road to get the unpredictable, contorted waviness. Sprinkle a pinch of sparkles into the lines. This is to represent the mica and quartz crystals that are often found within the Precambrian rock. Fill in any patches without sand with sparkles.

A Cautionary Note About Glue: From this point on, be very careful about glue. If you put on too much, it will run into the surrounding formations. Also, avoid shaking off excess sand by tipping the mat board up at a high angle. The wet glue can drip causing a mess on the column. Use a spoon to apply sand carefully and evenly. Use a piece of paper or a paper towel to wipe any off any extra below the formation that is being worked on.

Make a Stratigraphic Column
of Colorado National Monument

ACTIVITY PAGE

MAKING A GREAT UNCONFORMITY



ANCIENT ROCKS ARE SEVERELY COMPRESSED, FOLDED, & FAULTED; INTENSE PRESSURE & HEAT MAY PRODUCE DYNAMIC METAMORPHISM, CONTORTING &/OR RECRYSTALLIZING ORIGINAL ROCKS.

(FOLD & FAULT SHAPES HYPOTHETICAL; USED SIMPLY TO SHOW DISTORTION OF ORIGINAL ROCKS)

EROSION (ACTUALLY OCCURRING SIMULTANEOUSLY WITH COMPRESSION & UPLIFT) WEARS AWAY UPPERMOST ROCKS, GRADUALLY BEVELS OFF OLD, DEEPLY-BURIED ROCKS TO NEARLY FLAT SURFACE LYING NEAR SEA LEVEL.

(MEANWHILE, SO MUCH FOR THE ENTIRE PALEOZOIC ERA....)

SEDIMENTS FINALLY BEGIN TO BE DEPOSITED ON BEVELED SURFACE OF ANCIENT ROCKS – IN THIS EXAMPLE, CHINLE FM. HAS BEEN DEPOSITED, AND SAND DUNES OF FUTURE WINGATE SANDSTONE ARE PILING UP ON TOP OF IT. BRING ON THE DINOSAURS!

The Great Unconformity

6 Between the Precambrian rock and the Chinle Formation that lies above it is a mystery, a gap in time that local geologists call "The Great Unconformity". While the Precambrian rock is estimated to be 1.7 billion years old at Colorado National Monument, the Chinle Formation is approximated to be between 210 and 230 million years old. What happened to the rocks in between? No one knows the answer for sure, but geologists theorize that sediments that accumulated in this area during the mystery years eroded, and were then washed or blown away. This left the smooth, flat surface of the Precambrian rock that is found today.

To make the unconformity: Leave a small space atop the Precambrian rock and below the Chinle. Do not fill it in with anything.

The Chinle Formation

7 The Chinle Formation is a narrow layer of brick-red rock, intermingled with purples and greens. Composed of fine sand and silt, it was formed during an arid to semi-arid time when rivers meandered and flowed westward across the land, when volcanoes spewed, and when sediment accumulated. The Chinle is best known for its bright colors and petrified wood that seem to be at their finest in the Painted Desert and Petrified Forest National Park in Arizona. At Colorado National Monument, few fossils are found, for the soft slopes of the Chinle are often littered with rock fall and debris from the cliff-forming Wingate Formation that sits above it.

To make this formation: Spread a narrow band of glue above the Precambrian rock and the "unconformity." Smooth out the glue, then take a spoonful of Chinle sand and sprinkle them gently across the glue. Press pieces of the moss and shavings into sand and glue. Finish by attaching several pieces of gravel onto the Chinle to replicate fallen Wingate boulders.

Wingate Sandstone

8 Wingate Sandstone is the third formation that you will make. It is a thick rock layer, as much as 300 feet thick in places, and famous for its scenic quality. The unique rock monoliths and tall, orange to red cliffs that so distinguish Colorado National Monument are part of the Wingate Sandstone. In some parts of the Four Corners region, Wingate cliffs pose impenetrable barriers for travelers and explorers. Everywhere, they make for awe-inspiring scenery. This formation tells of a time, approximately 200 million years ago, when much of Colorado was buried under the blowing and drifting sand of a desert, not unlike today's Sahara Desert. When you look closely at Wingate cliffs, you can imagine how long-ago winds swirled sand first in one direction, then in the next. The shape of a monolith, such as the Coke Ovens, is reminiscent of the ancient dunes that once dominated this landscape.

To make this formation: Spread a wide band of glue across the mat board. Make swirls in different directions in it with the spoon or your finger. Cover glue with orange Art Sands™. As the glue dries, drag a toothpick from the top to the bottom of the formation to create long, vertical lines. Sprinkle a tiny bit of black Art Sands™ along these lines to represent streaks of desert varnish down the face of the Wingate cliffs.

Kayenta Formation

8 The Kayenta Formation is the next formation that you will make. It is dark red, sloped rock that is sandwiched between the cliffs of Wingate and Entrada Sandstones. In some places, the Kayenta is made up of soft, easily eroded shales. In others, it is hard, resistant sandstone with a high silica content. In this form, it functions as an important cover or "caprock" slowing down erosion of the Wingate underneath. Portions of Rim Rock Drive traverse the Kayenta Formation. Independence Monument has a small "cap" of Kayenta, which protects it from erosion. Created more than 190 million years ago when the region had many rivers and streams crossing it once more, Kayenta sand ranges from medium to fine-grained. During those times, dinosaurs and crocodile-like reptiles roamed the land, and in some areas of the southwestern United States, their tracks have been preserved, seemingly frozen in time.

To make this formation: Above the Wingate, make a narrow strip of glue, and cover it with a mix of dark red Art Sands™, and purple and gray Morrison sediments. Stick on a few wood shavings to represent thicker areas of sandstone. Draw in a dinosaur track with a toothpick.

Entrada Sandstone

9 Entrada Sandstone lies atop the Kayenta Formation. Although not as high or as orange in color as the lower-lying Wingate Sandstone, Entrada is still easily distinguished by its two-tier tendency. The lower (older) section is characterized by darker pink, salmon, orange, and brown colored sandstone cliffs. In the upper (younger) section, the Entrada forms white to pale salmon-colored sandstone that erodes into ledges and rock staircases. Over 165 million years old, the shapes, colors, and textures of Entrada Sandstone were created by wind-blown sand and dunes inland from the edge of an ancient sea. Not surprisingly, it is composed of rounded quartz sand grains held together by cements of calcium carbonate and silica.

To make this formation: Spread a smooth layer of glue above the Kayenta Formation. Use the back of the spoon, or your fingertip, to make swirl shapes in the glue. If you have sand left from the Wingate Sandstone, use it to fill in the lower layer of the Entrada cliffs. If not, mix together a small amount of orange and pink sand, and sprinkle them on the lower section of the glue. For the upper half, use white or tan river sand (or Art Sands™) to complete the sandstone cliffs.

Wanakah Formation

10 Next is the Wanakah Formation. Pronounced wuh-NAW-kuh, with emphasis on the second syllable, this narrow, ten foot band of reddish siltstone, with some green mudstones and clays, is not visible consistently through the monument or in the stratigraphy of the region. Where it crops out, it forms a distinct rock layer, approximately thirty feet thick, that is red in the bottom half and green in the upper. It is frequently covered with debris and rock fall from the Morrison Formation, making it difficult to identify in some areas. Yet, in other parts of Colorado, the Wanakah Formation is much thicker and more dramatic. Geologists think that this formation developed approximately 160 million years ago, when either a shallow sea ebbed in the area, or a large lake or playa dried up with a return to desert conditions. (Note to teachers: Due to the narrowness of this formation, and its similarity to the Morrison rocks above, you may want to skip this layer. Because it is included on several area maps, the Wanakah is listed here.)

To make this formation: Spread a thin line of glue above the Entrada Sandstone. Use a pinch of pink Morrison sediment, or red Art Sands™, to cover it.

Morrison Formation

11 The Morrison Formation follows the Wanakah Formation. Composed of fine white, pink, gray, and occasionally purple and green sediments, this is the thickest section of rock fully exposed in and around the monument. Formed approximately 150 million years ago, when fresh water was once more plentiful in the area, the Morrison Formation is a mixture of muds, silts, sands, and volcanic ash. Geologists theorize that swamps, lagoons, and river channels were part of a vast flood plain that extended from higher lands in west-central Utah eastward into Colorado. Volcanoes to the west spewed ash, which eventually drifted over the area. Fossils of vegetation, trees, mammals, turtles, lizards, amphibians, fish, fresh-water clams, crayfish, and snails, and a wide variety of plant and meat-eating dinosaurs have all been preserved in the Morrison rocks. They indicate what a rich and diverse environment it must have been in those long ago Jurassic times.

Geologists divide The Morrison Formation into three sub-units, which are called "members". The Tidwell Member is the oldest of the three, and occurs after the Wanakah Formation in the stratigraphic column. It is composed of bands of green, gray, and yellow mudstones and siltstones with a few thin gray limestone lenses. Next is the Salt Wash Member whose small cliffs and ledges of white to tan and rusty-colored sandstones alternate with bands of gray, green, and occasionally red mudstones. This alternating cliff-slope pattern is a useful characteristic in distinguishing the Salt Wash from the other members. Topping the Morrison Formation is the Brushy Basin Member. The youngest of the sub-units, it contains lenses of beige sandstone that emerge amongst bands of pink, tan, gray, green, and purple mudstones.

Note to the teacher: With younger students, and depending on the amount of time that you have, you may want to skip dividing the Morrison Formation into its members. Instead, the students can create numerous bands of colored sand and mudstone representing the Morrison Formation as a whole.

To make this formation: If you are making the three members of the Morrison Formation, make them one at a time so that you get the proper arrangement of sand-, mud-, and siltstones. This also keeps the glue from drying out. The Tidwell is first in the column, lying above the Wanakah Formation. The Salt Wash is next, followed by the Brushy Basin, the thickest of the members, on top. If you are not going to differentiate the members, simply cover a large area with glue, and smooth it with a toothpick or spoon.

To make the bands of colored rock, take one spoonful of colored sand at a time, and sprinkle a line of it from one side of the column to the other. Imagine that you are writing one line at a time on some homework, or drawing a rainbow. The lines do not have to be perfectly drawn, but you do want to create distinctive horizontal bands of color that vary in thickness and arrangement in the Morrison Formation. Alternate colors, making a line of white followed by one of gray, followed by one of pink, etc. Add in bits of peat moss to represent plant fossils. Periodically, place bits of gravel to symbolize the larger rocks that are occasionally found amongst the silt and mudstones. Lastly, tuck in broken bits of toothpicks to symbolize dinosaur bones.

Burro Canyon Formation

12 The Burro Canyon Formation is the second youngest rock in the monument area, and correspondingly, it is second from the top of the stratigraphic column. It marks the beginning of the Cretaceous Period. Its tan to brown sandstone cliffs stand out against the surrounding slopes of softer gray, white, and green mudstones. Conglomerate rock made of pieces of compacted gravel size rocks is also present throughout the formation. Together, they suggest an environment some 110 to 120 million years ago, when streams continued to flow from west to east, as in the earlier Morrison. Because the thickness of the Burro Canyon Formation varies throughout the region, disappearing altogether in some locales, some geologists theorize that it was also a time of substantial erosion.

To make this formation: Apply a layer of glue above the Morrison Formation. Sprinkle gray or gray-green sand onto the glue. Press in wood shavings, representing sandstone cliffs. Place pea gravel randomly into the sand as well.

Dakota Sandstone

13 Dakota Sandstone is the youngest rock found near the monument and tops the stratigraphic column for Colorado National Monument. Look for its tan to grayish sandstone cliffs that act as a hard “caprock” above the softer Burro Canyon and Morrison mudstones and siltstones. Because it formed during a time when a sea advanced westward from what is now the central part of the United States, Dakota Sandstone is considered to originate from shoreline and beach deposits. In some areas, coal beds are found interspersed with the sandstone, suggesting that marshy or lagoon conditions also existed in this region over 95 million years ago.

To make this formation: Spread a layer of glue at the top of the mat board. Sprinkle yellowish-beige river sand across the glue. Mid-way through the layer, place new dots of glue and affix a thin, broken line of charcoal bits, representing coal beds that are found within the Dakota in some parts of the western United States. Make more dots of glue and apply shells, to indicate that the Dakota was in part a marine formation.

14 The Stratigraphic Column is now complete. Set the completed columns aside to dry while the students put away supplies, and clean off the desks and floor. Refrain from pouring excess sand off the columns until they are dry. This will keep the glue from running all over the mat board, and ruining the effect of the two-dimensional column.

Labeling the Formations

15 The last step in the columns is to label the formations. It is best to wait until the next day so that everything is dry before labeling the rock formations. Go back over the "Stratigraphic Column of Colorado National Monument" handout with students, and make sure they are clear which formation is which. This makes for an excellent review of what students have learned in this exercise.

Conclusion

Making a stratigraphic column of Colorado National Monument gives each student a personal connection to the different rock formations, and a greater appreciation for the forces at work in creating and eroding rocks. From it, they get a clear sense of how rocks are formed in layers that build up in a sequence, one atop the other, from the oldest to the youngest. Perhaps the most enjoyable aspect of this activity is the opportunity for individual artistic expression in a scientific investigation. For most students, such an experience is truly memorable.

Extension

This exercise coordinates well with other activities in this chapter, including the "Stratigraphy Hike", the "Erosion Hike", and "Three Types of Rocks: The True Origins of Rock and Roll". Completed columns can be brought along on a field trip to Colorado National Monument to aid in rock identification. Study of the geologic time scale coordinates well with this activity. Lastly, this exercise is an excellent method of meeting Earth Science curriculum standards for fourth grade and up.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

Age Group

4th through 8th grades.

Purpose of the Activity

The purpose of the "Stratigraphy Up and Down Hike" is threefold. First, in the course of this 2-1/2 mile hike (round trip) in Colorado National Monument, students investigate rock formations as a real-life geologist might. Secondly, students travel through nine different rock layers on this hike, and use scientific and artistic methods to document them. Thirdly, they learn how to recognize different rocks by their color, hardness, texture, and relationships to other nearby strata.

Amount of Time Required

Two and one-half hours (for older groups) and three hours (for younger students) are needed to complete this activity.

Materials Needed

Supplies that each student will need are:

- ☐ Clipboard.
- ☐ Stratigraphy Field Notes: Worksheet #1 (one copy).
- ☐ Stratigraphy Field Notes: Worksheet #2 (three copies).
- ☐ Copy of the "Stratigraphic Column of Colorado National Monument."
- ☐ Pencil.
- ☐ Magnifying glass.
- ☐ Small nail.
- ☐ Watercolors and brush.
- ☐ Blank art paper to paint on.
- ☐ Small size cup to hold water.
- ☐ Water for mixing paint.

The watercolors, art paper, and cups can be kept by the teacher or chaperones for distribution at the Coke Ovens Overlook. For the safety of the children, and the safety of the monument's resources, the nails should also be kept by an adult, and distributed only when required.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

Background Information

Students should be properly prepared for this outing. This is a backcountry hike into an area of the park that has no services, and is distant from other people. Therefore, everyone in the class, including chaperones, needs good hiking shoes, clothing appropriate for the weather, snacks, lunch, water bottle, and a backpack to hold everything. While students will carry most of their own materials for this activity, the teacher and chaperones may want to distribute supplies among their packs to lighten the loads of younger students.

Colorado National Monument Stratigraphy

First and foremost, this hike is a marvelous way to explore Colorado National Monument. Spectacular views into Monument Canyon inspire geologic inquiry. Area stratigraphy is presented close-up, as students traverse through time in a real-life stratigraphic column, that includes the Morrison and Wanakah Formations, Entrada Sandstone, and Kayenta Formation. At the highest and lowest points of the hike, Dakota Sandstone, Burro Canyon Formation, Wingate Sandstone, Chinle Formation, and Precambrian rocks are also visible, to complete students' experience of the column. Scientific investigation and artistic expression are the methods that the class uses to explore and record the textures, colors, hardness, and beauties of the different rock formations. Because the hike takes place on trails lightly used by visitors, the group can spread out and immerse themselves in investigations of the rock strata. Together, the impressive vistas and the hands-on inspection of rocks keep student involvement and energy at high levels.

The "Stratigraphy Hike" takes place in the center of Colorado National Monument, along the C.C.C./ Upper Monument Canyon/ Coke Ovens Trails. These adjoining trails can be accessed from Rim Rock Drive, just past Artists Point (if you come from the East (Grand Junction) Entrance or just beyond the Coke Ovens Overlook if you come from the West (Fruita) Entrance. En route to the trailhead through the monument, take note of the fascinating views of rock layers and rock sculptures that you pass.

Stratigraphy Defined

The study of layered rocks and their origins is called **stratigraphy**. It is a branch of geology that developed after people observed that rocks found in one area matched those found in other locales. As geologists studied more about rock layers, they learned that sedimentary rocks form in horizontal beds, only later to be bent, folded, cracked, transformed — and eroded. Over time, investigations showed that the younger rock layers rested on top of older rock strata. These fundamentals of geology became essential to the study of stratigraphy, and are very helpful for young geology students today. The activity, "Make a Stratigraphic Column," will also give students useful background on this subject. It can be helpful to bring the columns along on this hike.

Stratigraphy Up and Down Hike

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Colorado National Monument was established, in part, because of its stratigraphy. Nine rock formations are exposed within the canyons and mesas, each encapsulating an environment that previously existed in the region. The forces of uplift, faulting, and erosion have brought rock layers that were deep within the earth back to the surface once more. That so many conditions, from deserts to rivers, to oceans and beaches, and back again, can be found in order in one area is remarkable and curious for geologists and visitors of all ages. The dramatic relief and exposure of the strata is what inspired John Otto and other local residents to strive to set aside the canyons for protection by the National Park Service. In 1911, this area was designated a National Monument by presidential decree, thereby preserving "the extraordinary examples of erosion" and "natural formations" of this dramatic landscape.

What is a Stratigraphic Column?

A tool that geologists use when studying about rock formations is the **stratigraphic column**. It is a type of diagram that looks at the Earth from within it, instead of down onto it from above, as a road map does. A stratigraphic column views layers of rock from the side, as they rest one upon the other, from the deepest layers known up to the surface of the Earth. To understand how the column works, imagine nine pancakes piled up on each other in a stack. A knife cuts through the stack to remove a huge bite. Afterward, the inside layering of the stack is revealed. The different pancakes, as well as the places where the pancakes touch, become visible. This point of view is similar to that of a stratigraphic column, which looks at layers of rocks laid atop one another. Just as the knife reveals the inside of the pancake stack, so, too, the stratigraphic column shows an portion of the Earth's crust sliced open with the rocks inside exposed.

Geologists utilize stratigraphic columns to identify, compare, and study about the different layers of rock that are part of the Earth's crust. Because rocks are unique mixtures of minerals, each having a specific composition, fossil life, texture, color, thickness, and hardness, geologists can distinguish them, just the way a detective uses fingerprints to identify a person. Since rocks occur in a sequence of layers that holds true across vast areas, stratigraphic columns help geologists to predict that if they are standing against the deep orange and brown cliffs of the Wingate Sandstone, then below them should be the Chinle Formation. When the sequence of rocks is broken because some of the layers are missing, geologists gain just as much information by these "unconformities".

What is a Rock Formation?

Key elements of the stratigraphic column are the rock formations themselves. Geologists define formations as mappable units of rock that were deposited under a particular set of conditions. Within a formation, all the fossils represented are similar, as are the materials composing the rocks.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

At different times throughout the Earth's history, the environment has changed. Sometimes the seas have been high; at other times low. Sand dunes and deserts have predominated in certain periods, while swamps and freshwater inhabitants have taken over in others. Each one of these environments has left a record of its plant and animal inhabitants, soil, climate, and conditions on the Earth's surface. New life built on the roots of the old, leaving a fresh story of what occurred atop that of the past. It is the rocks layered upon each other, yet distinct from those around them, that geologists use to interpret Earth's history.

Type Rocks

Each rock formation is identified with a name. The name is usually based on the area where the features were first studied and identified. For example, the Morrison Formation, known for its bands of multi-colored rocks, siltstones, mudstones, and extensive deposits of dinosaur bones, gets its name from the town of Morrison, Colorado, where it was extensively studied. The **type** rocks for this section were established there, and form the basis for comparison throughout the world. When similarly banded rocks are discovered in other places, they are compared with the type rocks to be sure of their identification.

Definitions such as those above will be helpful in the "Stratigraphy Hike" both for aiding in the identification of rocks and in the completion of the worksheet. While there are technical parts of the activity, there is also a creative, artistic element that gives balance to the experience. Children seem to enjoy as well as benefit by the mix.

How the Colorado National Monument Stratigraphy Column Will Work

The stratigraphic column designed in this exercise is more conceptual and artistic than one a working geologist would use. It involves answering questions about characteristics of different rock formations that are encountered on a hike on the C.C.C. Trail and adjoining Upper Monument and Coke Oven Trails. At the end of the trail is an overlook of the Coke Ovens monoliths where students have excellent views of the rock strata as they are in sequence from the youngest at the top of the column to the oldest in the depths of the canyon. Before this dramatic vista, they will use watercolors to paint their impressions of the stratigraphic column of Colorado National Monument.

A Word of Caution About the Trail

This trail is spectacular from a geologic perspective, but also rocky and narrow for hiking. Teachers should be sure to keep students together, and under control. Travel should be at a slow pace, with chaperones scattered amongst the group. A ratio of one chaperone per five students is advised for this outing. No more than one to two classes should do this activity at one time. In addition, because the class will be in an area that is distant from services and the Visitor Center, children and adults should be well prepared for a backcountry hike.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

How to Do the Activity

Getting Ready - Preparations

1 To assure that all goes safely, a large number of chaperones — a ratio of 5 students per adult — is recommended. While the hike can be done with fewer adults, this ratio is especially important with energetic groups, and will ease the mind of the teacher throughout. Since many parents need advance notice to take time off from work, or to arrange a babysitter, send out a notice about the hike several weeks ahead of time.

2 As part of planning the outing, the teacher should review "Preparing for Your Field Trip" (Chapter 1), and the "Rocks Before You" section on geology. Information in both these areas will give a base of knowledge and material that will assure that the exploration goes smoothly and successfully. If desired, copies of information can be given to chaperones as well.

3 Gather materials that are needed for the hike. Parents may be able to assist you in locating some supplies. Copy off worksheets and information on the different rock layers for students to use. The sheets can be stapled together to make a small geology field notebook if desired.

4 This hike will take two and one-half to three hours depending on the ages and abilities of the students. As a result, the teacher may want to plan a full day outing, including a stop at the Visitor Center, picnic at Saddlehorn or Devils Kitchen Picnic Areas, short hike along the Alcove Nature Trail or Otto's Trail. A tour of the Colorado National Monument along Rim Rock Drive, with stops at the many scenic overlooks, would be another excellent accompaniment to this activity.

Parking for Cars and Buses

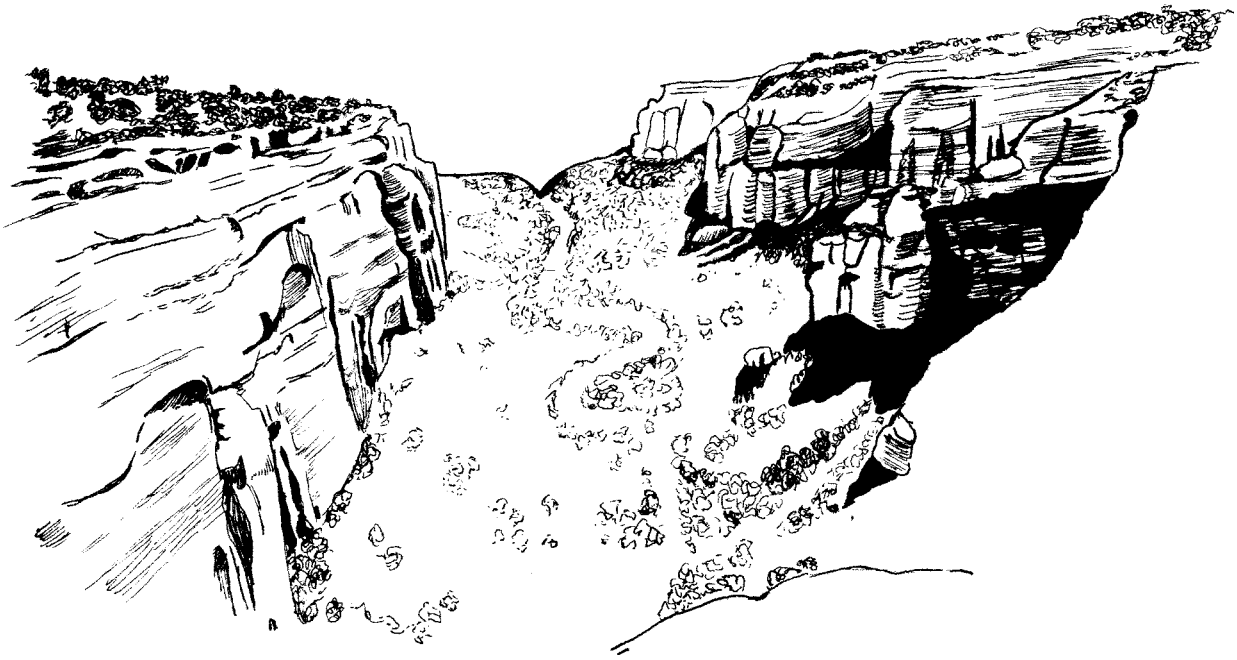
5 Parking at the trailhead for this activity is limited to two bus lengths in size, or approximately six cars. Since park visitors also use the trail, make careful arrangements if using a carpool. Additional car and bus parking is available at Artists Point and the Coke Ovens Overlook, both of which are located nearby, to the east and west of the trailhead. Because walking along Rim Rock Drive is not recommended, drivers should drop students at the trailhead, park their cars, and then walk back to meet the group. Urge caution along the road, and be sure to watch out for cars.

Appropriate Clothing for a Field Trip

6 **The day before the hike**, ask students what is appropriate clothing for the weather. Make a list on the board of their answers. Have them make a list of what they should bring in their backpacks for the hike. Lastly, take time to define and discuss what stratigraphy is, how it helps scientists, and how to make a stratigraphic column. You may want to coordinate this hike with the "Make A Stratigraphic Column" activity shown elsewhere in this chapter. It is a good introduction or follow-up to this hike.

Stratigraphy Up and Down Hike

ACTIVITY PAGE



Step-by-Step Instructions for the Stratigraphy Hike

The day of the field trip, and before you leave the classroom, double check the gear of the students to be sure that they have all the supplies that they need. *Remind students to use restrooms at school beforehand*. There is neither a restroom, nor an easy place to go to the bathroom trailside on this hike. The narrowness and the lack of cover on the trail create difficulty in finding appropriate places to defecate or urinate. The trail itself should not be used!

What to Look for on the Way to the Monument

En route to the monument, ask students and drivers to pay attention to the rocks that they pass. Notice the different colors, shapes, textures, and hardness of the rocks. If you enter from the East (Grand Junction) Entrance, have students compare the rocks they see outside of the Entrance with those that they see as the road climbs up to the top of the mesa. If you come from the West (Fruita) Entrance, observe how the road must wind around the face of the mesa. Why is that? Get everyone to notice where changes in the rock take place: cliffs become talus slopes; black rock shifts to red or orange rock; shrub-covered slopes turn back to cliffs. Observations like these will help to set the scene for more in-depth study on the "Stratigraphy Up and Down Hike."

Stratigraphy Up and Down Hike

ACTIVITY PAGE

The Trail – C.C.C./ Upper Monument Trail

The "Stratigraphy Up and Down Hike" takes place along the C.C.C./ Upper Monument Canyon/Coke Ovens Trails. They are located in the center of the monument, about halfway along Rim Rock Drive from either entrance. Artists Point and Coke Ovens Overlook are nearby. Because parking is limited, drivers should pull as far forward in the lot as they can to make room for other vehicles. If there is not room for all the cars, then drop students off at the trailhead, and send drivers to park at the Artists Point or the Coke Ovens Overlook lots. They can walk back to the group. Keep students off Rim Rock Drive if possible. Everyone should bring their backpacks, clothing, food, water, and project materials when they gather at the park map and sign at the top of Upper Monument Canyon/Coke Ovens Trails. A set of wooden steps and trash can are nearby, but there is no restroom.

Stops Along the Trail

The following is a description of the stopping places on the trail, what is found at each one, useful information for the students, and explanations of what to do.

Introduction at the Trailhead

While everyone gathers at the sign for the Upper Monument Canyon/Coke Ovens Trails, ask the students to describe some of the rocks and rock formations that they saw on their way from school. No doubt they will mention the large orange-red cliffs that they passed, but try to get them to describe some of the other colors, textures, and types of rocks that they observed. This makes a useful warm-up to the identification of rock formations on the "Stratigraphy Hike".

Because students have been cooped up in a bus or in cars during the drive, the best way to begin this activity is to hike up the C.C.C. Trail non-stop, one-quarter mile, to a wide meadow. The views from that point are an excellent place to begin in-depth observation and discussion. Thus, use the time at the sign for people to gather, and to handout materials that you will use on the hike. Reviewing trail safety rules, and reminding everyone about the no collecting regulation in national parks and monuments is paramount. Ask chaperones to spread out amongst the group, and designate one adult to be at the end of the group for safety. The teacher should be the leader.

Begin the hike on the C.C.C. Trail which is located across Rim Rock Drive on the *opposite* (southwest) side from the trail sign where the group just gathered. Look for the C.C.C. trail sign across the road from the north end of the parking area, the one that is closest to the Coke Ovens Overlook. Soft, reddish-maroon rock of the Wanakah Formation follows along the road there.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

The C.C.C. Trail

The C.C.C. Trail was named after the Civilian Conservation Corps (C.C.C.), which came to Colorado National Monument in the mid-1930's to help with the construction of Rim Rock Drive. This trail connects an old cattle and logging road atop Black Ridge with the sites of the C.C.C. work camps along the canyon rim. After the hardships of the Depression, the C.C.C. was part of the Roosevelt Administration's effort put people back to work, to teach job skills, and to improve conditions in people's lives. Besides Colorado National Monument, there were several other sites chosen for C.C.C. projects in Colorado, including Mesa Verde National Park, Rocky Mountain National Park, Garden of the Gods, and Grand Mesa.

From the road, you will go steadily upward. The trail makes three switchbacks before straightening out. Next, follow a wide curve to the left as you go up the ridge. Approximately one-quarter of a mile along the trail, the trees open out onto a grassy meadow. While your group may find many interesting rocks in and along the path, save exploring them until you begin the trip back down the hill. Use this part of the hike to stretch legs, use up excess energy, and just enjoy the day.

Stop #1: The Meadow

When the group reaches the open, grassy meadow, they can put their backpacks on the ground, take a short break, and relax. This is a good place to have a snack and drink of water.

Caution students to step carefully here, because the meadow contains cryptobiotic soil crust, a black, lumpy covering on the ground. It is easily damaged when people walk on it. By looking carefully where they step, and where they put their backpacks, students can avoid harming it. For more information about cryptobiotic soil crust, see the activity, "The Magic of a Drop of Water", in the "Plants of Colorado National Monument" chapter.

The main reason to stop in the meadow is the view, which encompasses almost all the different rock formations found in the Colorado National Monument, as well as those in the Grand Valley and the Book Cliffs. Such an expanse of rock offers an excellent introduction to the activity and to the concepts underlying it.

When the break is over, ask students to be seated along the trail, and get out their clipboards, worksheets, and pencils. The teacher should explain that from this point on, students will be learning an important element of geology known as "stratigraphy". An explanation of how geologists use stratigraphic columns to learn about the rock formations in places such as Colorado National Monument should also be given. While this information is fresh in students' minds, they should write down their definitions of stratigraphy and stratigraphic columns on the "Stratigraphy Field Notes Worksheet #1."

Stratigraphy Up and Down Hike

ACTIVITY PAGE

Next, ask students to look out at the view of the mesas and canyons before them. Have them guess how many different rock formations are out there. Can they actually count the rock layers? How many do they find? (The correct answer is eleven, with nine in the monument and two visible on the Book Cliffs on the opposite, or north, side of the Grand Valley.)

Students should then look at the gray, fluted rock of the Mancos Shale that composes much of the cliffs and mesas that line the far (northeast) side of the Grand Valley. What characteristics of it make it distinct? Some of the features that the class might notice are: single, solid color; seeming single texture; fluting of sides of the rock from erosion that is unlike any other rock nearby. Such observations will parallel the definition of a rock formation given previously: rocks that are layered upon each other, yet distinct from those around them, are likely created under a similar set of conditions. Within a formation, all the fossils represented are the same, as are the materials composing the rocks.

Ask the class to look above the Mancos Shale to what is above it. Is this the same or different rock? What distinguishes the two? (Observations should include that the brown color is different, and the cliffs that form make this layer appear to be a harder rock.) A final question is to ask students to point out other "formations" that they observe around them. Such observations lead very easily to a definition of rock formation, which is the third question to be answered on Stratigraphy Field Notes Worksheet #1.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

Area Stratigraphy

Rock formations to note from this vantage point are:

1 **Mesa Verde Formation**: Brown and tan sandstones create a thick block of cliffs atop the Mancos Shale. This formation is among the youngest rocks to be found in the area, dating back to the Cretaceous Period.

2 **Mancos Shale**: These gray to black thinly-bedded shales were formed during a time when this region was covered by an ocean. Although this formation is very thick, it is also very soft, and easily erodes into valleys and ridges, creating a scalloped effect.

3 **Dakota Sandstone**: The microwave towers on Black Ridge are located on an outcrop of this marine sandstone. Look for its beige, yellow-brown cliffs that form a distinctive ledge at the top of the mesa.

4 **Burro Canyon Formation**: This white, gray, beige sandstone and siltstone forms tree and shrub filled slopes that are broken up by numerous small sandstone outcroppings. You can see it above the meadow, and below the top ridge of Dakota Sandstone.

5 **Morrison Formation**: A colorful array of soft gray, white, pink, purple, and green siltstones, mudstones, clays, sandstone and shale are broken up by periodic, thick, tan sandstone ledges. Found beneath the Burro Canyon, and throughout the area of the meadow where students are currently. Many blocks of Morrison sandstone are in and along the trail as you go back down the ridge.

6 **Entrada Sandstone**: A distinctive band of salmon to white-colored cliffs rise off to the east and north. They form a smooth, rounded ledge that rims the steeper canyon walls below.

7 **Kayenta Formation**: Heavily vegetated slopes below the Entrada are composed of thin layers of red, tan, gray, and purple silt and mudstones. Across much of the top of the mesa, Rim Rock Drive is built on this formation.

8 **Wingate Sandstone**: Many of the sculptured and named features of the Monument are made of eroded Wingate Sandstone. It also creates the dramatic reddish-brown to orange cliffs that so distinguish the canyons here.

Spend about fifteen minutes discussing stratigraphy and looking at the different rock formations from this vantage point. Then, proceed back down the ridge. You should have been out for approximately thirty minutes by this time. **Be sure that no food, litter, or other belongings of the group are left behind.**

Stop #2: The Morrison Formation and Worksheet #2

After the wide curve on the C.C.C. Trail, the path narrows, and you enter some trees. In this portion of the trail, look for rocks such as pink and white striped or beige sandstones, or gray mudstones and siltstones scattered along the path. These rocks are characteristic of the Morrison Formation. This is a good stopping spot for completion of "Stratigraphy Field Notes Worksheet #2", which involves a close-up inspection of one rock.

Each student should have three copies of "Worksheet #2", one copy for use here. The questions on it direct the student to investigate a rock of their choosing for color, texture, grain size, and hardness. The techniques used on this exploration are similar to those used by geologists in the field, when they identify and record information about rocks. As students answer the questions on "Worksheet #2", and use their fingernails, small nails, and magnifiers to examine their rocks, the teacher and chaperones should float among the group to assist with any questions or problems. The worksheet should take no more than 10 to 15 minutes to complete. Those students who finish quickly can go further down the trail to the road with an adult. Several rocks of note along the way are large boulders of sandstone that show distinctive signs of weathering, including impacts of lichens, tree roots, heat and cold. All rocks should remain in place, and only notes and impressions from the rock be taken away.

It is recommended that a time frame for completing the worksheets be established at the start of this segment, so that the group will have plenty of time to do the other activities on the hike. Ten to fifteen minutes should be adequate to fill in the worksheet.

Hardness Test

A Note About the Use of Nails: Hardness is one of methods by which geologists investigate rocks. Nails are often used to evaluate where a rock fits on the Mohs scale of hardness. The softest mineral, talc, has a hardness of 1. Gypsum has a hardness of 2. A fingernail will make a scratch mark on any rock with hardness of 2 or under. A rock with a hardness of 3 to 5 will show a mark when scratched by a nail, but not a fingernail. If a nail does not leave a mark, then the rock must have a hardness of 6 to 10. Quartz is rated at 7, topaz at 8, corundum at 9, and hardest of all, diamonds, are rated at 10. In our area, there is a lot of quartz mixed in with other minerals. Therefore, if your rock does not show a scratch from a nail, it is likely that quartz is making it so hard.

Hazards

Nails, however, can be a safety risk with children. Not only do they have sharp points that could injure a student, but they can also do damage to the environment. In the hands of some individuals, nails can lead to scratches and marks that do permanent harm to rocks, trees, or plants. Such "graffiti" is actually forbidden under federal law, and can result in fines or ticketing. Therefore, the teacher must think carefully about whether the benefits of using a hardness test are worth the potential risks.

Should nails be used, instructions about making only a TINY scratch are essential. This should be done only on a part of the rock that will not show it or be damaged by it in any significant way. Teachers and chaperones should keep a close eye on all students using nails, and request the nails be returned upon completion of the test.

Should no nails be used, then students should attempt the fingernail scratch test, and questions regarding hardness over level 2 on the worksheet should be skipped.

Stop #3: The Wanakah Formation (optional stop for those who finish their worksheets more quickly)

The C.C.C. Trail ends at Rim Rock Drive, where the surrounding rock is from the Wanakah (pronounced wuh-NAW-kuh, with the emphasis on the second syllable) Formation. This stop can be for those students who finish up their worksheet quickly. It can be skipped if time is "eroding" rapidly. Those who have time should explore this layer of rock to determine how it is different from the Morrison. As the group comes down the trail to the road, can it spot the place where the Morrison Formation ends and the Wanakah Formation begins? The bottom of the Morrison is sandstone about two feet thick.

Features that distinguish the Wanakah Formation are:

- It is only about thirty feet thick, as compared to the Morrison, which is over 450 feet thick.
- It is composed of 15 feet of thin, horizontal beds of reddish siltstone overlain by another 15 feet of gray, green, and light brown mudstones and shales. In spite of its banding, its location between the more thick, colorful, and dramatic exposures of the Morrison Formation and the Entrada Sandstone makes it easy to miss.
- The thin, uniform strata create long, even lines reminiscent of wet hair that has just been combed, or of a newly raked sand trap on a golf course.
- To the touch, the Wanakah is soft and crumbly, and it is much easier to scratch with a nail than either the Morrison Formation or the Entrada Sandstone.

No record of this formation needs to be made unless there is plenty of time for the group to complete the rest of the hike, which will take from one to one and one-half more hours. Once students are familiar with the way that the worksheets go, they should be able to complete them more quickly.

Stop #4: The Wanakah / Entrada Interface

Cross the road back to the parking lot and the Upper Monument Canyon/Coke Ovens Trail sign. **Reconvene the entire group before heading downwards into the canyon.** Once everyone is together, ask the students to be geologic detectives in the next section of the trail. They should look for the spot where the Wanakah Formation stops and the next formation, Entrada Sandstone, begins. Tell them to keep in mind that the lower Wanakah is red to brick-red in color, whereas the Entrada is harder, white to salmon-pink to tan-gray in color. While the Wanakah is soft and crumbles easily, the Entrada is a harder, more ledge-forming, sandstone.

Challenge them to spy the change without any clues. If not, direct them to look approximately 25 to 40 steps down the path from the stairs. There, on the right-hand (uphill) side, is the place you are looking for, where reddish sloping rocks give way to a ledge of fine-grained, white to tan-gray sands that bulges out beside the trail. The Entrada begins at about knee height and with each step down the trail gets higher and more distinct. Just before the first switchback, the transition to this new formation is complete.

There is plenty of room along the trail in this area for everyone to observe the change in texture, color, hardness, and grain size that has taken place. Whereas the Morrison is a mixture of different types of rock, from sandstone to mudstone, siltstone, and clay, the Entrada Sandstone is remarkably similar throughout. While its color may change from white to pinkish orange, it has a uniformity of grain size and texture. Formed when desert-like conditions and wind-blown sand covered this region, those ancestral dunes were eventually compacted and compressed to create the rounded cliffs now exposed in the stratigraphic column.

Drainage Tunnel

A Note of Caution in This Area: Students will undoubtedly discover a large "cave" or cavern off the trail and across the drainage. While it beckons to them, *do not attempt to go there*, even if you see other visitors by it. Getting to the "cave" is not safe due to loose rocks, and awkward climbs. What may appear as a path is really a pile of jumbled boulders that are not firmly in place in the soil. It is not recommended that anyone go there. Instead, explain that while Rim Rock Drive was being built, efforts were made to prevent the road from washing out or being damaged in storms and flash floods. Because several small canyons bisect the road right here, the road builders did extensive drainage work. What appears as a cave is really a drainage tunnel directing run-off from the Morrison and Wanakah Formations above the road under the roadbed and down into the canyon. This tunnel is not a place to be during a rainstorm!

Stop #5: Entrada Sandstone

Just past the Entrada and the view of the drainage tunnel is the first switchback. Keep students under control and walking carefully in this section of the trail. Seasonal and flash floods have washed boulders and debris down the drainage on the right. While it may be hard to imagine the force of a raging torrent of water down this stream bed now, remember that water is a powerful agent of erosion, and capable of transporting large rocks as if they were small. (For more information on erosion, see the "Erosion and Weathering Hike" in this chapter.)

The second switchback is the site of the next extended stratigraphy exploration. Just off the path, on the uphill side, is a long expanse of Entrada Sandstone that students will investigate using another of the "Stratigraphy Field Notes Worksheets #2". Several logistics are important along the trail at this point.

Ask students to find a place along the trail around the switchback to put down their backpacks and be seated. Ask them to leave room enough for people to move up or down the path without hindrance. This is a public trail, where other park visitors may be hiking. Station adults at either end of the group so that no students stray along the path, and so that the group can be alerted to hikers coming through. The teacher should stand in the center of the group by the sandstone cliff.

In small groups of eight to ten, students should approach the cliff to make measurements and observations. They may step off the trail to get close-up views of the texture and color of the Entrada Sandstone cliff with their magnifiers. While one group works, the rest of the students can answer questions about other features of the formation that do not require such inspection.

All measurements may be made on the Entrada Sandstone *with the exception of the nail scratch*. Scratches on rock, such as sandstone, can leave a permanent mark. The teacher should ask students to observe where other people have scraped their initials into the rock. Can the children tell who made them? Why do they think that people did this? What effect do these markings have on how the students feel about the rock? Is carving your initials in a rock the proper thing to do? Answers to these questions are subjective, but in the eyes of the National Park Service, markings on rocks by modern people are the equivalent of graffiti. Damaging rocks breaks federal laws prohibiting harm to trees, plants, wildlife, insects, and rocks that are part of Colorado National Monument. While ancient peoples used rock art as a means of communication and expression, initials or designs scratched in the rock by modern people are not considered to be art or of value. Thus, the class will not use the nail to do a hardness test in this area. Instead the group will estimate hardness based on the existing carvings on the cliff. Hardness estimates should be approximately 5.

To conclude with the Entrada Sandstone, ask the young geologists which formation they think is the oldest: the Morrison Formation or the Entrada Sandstone. If they have understood the concept of the stratigraphic column, they should say the Entrada. For more details on age and environments that once existed here, please refer to the "Stratigraphic Column of Colorado National Monument" or "Make Your Own Stratigraphic Column" activity in this chapter.

Take the Coke Ovens Trail at the Intersection

In about twenty minutes, when the worksheets are complete, hike on to the next trail marker. It is located where the Upper Monument Canyon and Coke Ovens Trails divide. **Your group will take the Coke Ovens Trail**, to the right, and head along the canyon wall to the east.

Stop #6: Entrada Sandstone - Kayenta Formation Contact

After the trail marker, and the right-hand turn, the group will go down some steps to an area of flat smooth rock. Stop here for a moment. Another portion of Entrada Sandstone is exposed on the uphill side. Where it ends, seemingly abruptly, is the Kayenta Formation. The Kayenta Formation is the fourth rock formation that will be investigated in depth on this "Stratigraphy Up and Down Hike". Whereas the Entrada forms a distinct band of cliffs, the Kayenta forms ledges and slopes that are more easily overlooked. Nevertheless it is significant in the stratigraphic column because its bottom layers, those contacting the Wingate Sandstone, are very strong, and resistant to erosion. In fact, they protect the Wingate Sandstone from erosion in such places as Independence Monument. Where Kayenta has eroded, such as off the tops of the Coke Ovens, the Wingate, too, has worn down into rounded domes. (See *Colorado National Monument Official Map and Guide* for a good photo of the effects of erosion here.) The Kayenta's durability made it the choice for construction of much of Rim Rock Drive on it across the mesa top.

At this point, ask the students to be geologic detectives again, only this time, they should find where the Entrada Sandstone ends and the Kayenta Formation begins. As the trail follows the interface of these two formations, many students should be able to identify the exact places where the two meet. Color, texture, layering, and shape of the rock should make the distinction easy. If there is time, have students make a record of this interface using their third copy of "Stratigraphy Field Notes Worksheet #2". What differences do they observe between the colors, layering, and textures of the Entrada and Kayenta? Avoid using the nail for a hardness test, except if an adult, or the teacher, would demonstrate it for the entire group.

The last stop is down the trail at the Coke Ovens Overlook.

Stop #7: Coke Ovens Overlook

The trail follows the Kayenta Formation for approximately one-third mile until it ends at the Coke Ovens Overlook. This fenced vista point affords dramatic and expansive views of the stratigraphy of Monument Canyon. Have the group stand at the fence and look down at the canyon below. Can they see some of the other rock formations in the stratigraphic column of Colorado National Monument? As geologic detectives, they should be able to recognize three more formations below them.

The group is standing on the dark red-brown layer of the Kayenta Formation. Its horizontal layers of rock top huge, smooth cliffs of orange, brown, and black called the Wingate Sandstone. Can everyone locate an expanse of the Wingate Sandstone? Which would be older in the stratigraphic column: the Entrada Sandstone or the Wingate Sandstone? Hopefully the students will respond with the Wingate Sandstone, which lies lower in the column and deeper in the canyon.

Still lower in the column, below the Wingate, are the maroon-colored slopes of the Chinle Formation. They are littered with rocks fallen from the cliffs above, and sprinkled with shrubs, pinyon pines, junipers and grasses. Next, look still deeper into the canyon, to the very bottom, for the slate gray, pink, and black Precambrian rock, the oldest rock found in Colorado National Monument. It is called the "basement rock" of these canyons, because all other strata rise above it. Recognizing these different formations should be relatively easy for the class now that they have seen so many different colors, textures, and hardness in the rocks. While they may not remember individual formation names, relationships of rocks to one another — harder caprock protecting softer rock below, slopes littered with debris from cliffs above, the stair step effect of Entrada cliffs above Kayenta slopes above Wingate cliffs above Chinle slopes — should be more clear in their minds. What they have learned and observed should be reflected in the final activity of the "Stratigraphy Up and Down Hike", painting a stratigraphy column of the canyon around them.

Ask students to find a place to sit at the overlook where they have a view of the canyon that they like. Pass out art paper, cups, watercolors, and brushes. Instruct students to design and paint their own stratigraphic column of the formations of rock that compose the mesa and canyon that they have just explored. Remind them that the youngest age rock, Dakota Sandstone, is found at the highest point in the area, whereas the oldest rock, Precambrian, is found in the depths of the canyons. Encourage the artists to strive to match the colors of the rock with the paints before them. To give them an idea of what their column should look like, show them the "Stratigraphic Column of Colorado National Monument" that is a part of this activity. If students seem to have difficulties, let them copy the structure of the column but have them make their own colors.

Plan 15 to 20 minutes for this activity. For those that finish quickly, have them label the individual formations, or paint a vista that they especially like. Gather up the paper cups, pouring the colored water back into a water bottle. Before heading back up the trail, do a careful check of the area for litter or items left behind. The return trip should take 15 -20 minutes.

Conclusion

The "Stratigraphy Up and Down Hike" combines both scientific inquiry and artistic expression in the exploration of the rock formations of Colorado National Monument. The hands-on investigation makes the rock layers come alive for the students in a way that cannot be replicated in a classroom setting. The "Stratigraphy Field Notes Worksheets #1 and #2" not only help to focus students' attention on the differences between the individual formations, but they increase awareness of and appreciation for the overall stratigraphy and geologic processes of the region.

Stratigraphy Up and Down Hike

ACTIVITY PAGE

Ways to Adapt This Activity for Other Ages

The "Stratigraphy Up and Down Hike" is not recommended for children below 4th grade. This is due both to the narrowness of the trail, and to the more complex subject matter, which is difficult even for some adults to grasp! Older age groups, including junior high school, high school, college students, and adults will enjoy the hike immensely. The hike can be shortened by eliminating the worksheets. The watercolor stratigraphy column should be kept in the hike if at all possible. Capturing the diverse colors and textures of the rocks with paint is remarkably effective for integrating useful geologic information with artistic expression.

Extensions

The "Stratigraphy Up and Down Hike" is an excellent complement to "Make a Stratigraphic Column," "Three Types of Rock" as well as the "Erosion Hike". It can relate to work in the classroom including researching details on individual rock formations or geologic principles.

Stratigraphy Field Notes:
Worksheet #1

ACTIVITIES FOR STUDENTS

1) Fill in the blanks to complete the sentence.

Stratigraphy is the study of _____

_____

_____

A stratigraphic column is a _____

_____

_____

A rock formation is _____

_____

_____

2) Answer True or False.

The rock at the bottom of a stratigraphic column is younger than the rock at the top.

☐ True ☐ False

All rock formations have the same hardness and texture.

☐ True ☐ False

Rock formations help geologists to learn about the kinds of environments that used to exist on the Earth.

☐ True ☐ False

3) Make a list of words that describe the environment around you today. (Hints to get you going: Is it an ocean? Is it a desert? Is there fresh water? Are there lakes, rivers, streams, swamps, bogs? What is the temperature like? Is it humid or dry? Is it windy or not?) _____

_____

_____

4) What kinds of things do you think will be preserved from our time on Earth for future geologists to discover? What will "fossils" from our civilization look like? _____

_____

_____

Stratigraphy Field Notes:
Worksheet #2

ACTIVITIES FOR STUDENTS

Find a rock that interests you, big or small. Look at it closely, and answer the following questions.

Caution!! Rocks may be the home or hiding place for insects, spiders, birds, or reptiles, like rattlesnakes and lizards. Choose your rock with care, so as to avoid disturbing creatures that may be using it. Always look your rock over, checking the areas on top, beside, and below it before touching or investigating it. Remember, you are merely a visitor here. That rock may be some animal's shelter, nest, protection from predators, or place for avoiding heat or drying out.

Size — My rock is about the same size as:

- ☐ my fingernail
- ☐ my foot
- ☐ my backpack
- ☐ my bed at home
- ☐ a school bus
- ☐ it's HUGE!

Texture — Touch your rock with your fingertips, then describe how it feels.

- ☐ soft
- ☐ bumpy
- ☐ hard
- ☐ crumbly
- ☐ smooth
- ☐ rough
- ☐ other: _____

■ Look at your fingertips after touching your rock. Did any material come off on your fingers?

☐ Yes ☐ No

■ If your fingers feel powdery, you may be touching siltstone, shale, or mudstone. If they feel sandy, you may be touching sandstone. Can you guess what your rock is? _____

Hardness

Geologists determine hardness using the Mohs scale. The softest mineral, talc, has a hardness of 1. Gypsum has a hardness of 2. A fingernail will make a scratch mark on any rock with a hardness of 2 or under. A nail will leave a scratch mark on a rock with a hardness of 4 or 5. If a nail does not leave a scratch mark, then the rock has a hardness of 6 to 10. Quartz is rated at 7, topaz at 8, corundum at 9, and hardest of all, diamonds, are rated at 10. In our area, there is a lot of quartz mixed in with other minerals. Therefore, if your rock does not show a scratch from a nail, it is likely that quartz is making it so hard.

■ Scratch your rock with your fingernail. Do you see a mark on the rock?

☐ Yes ☐ No

Stratigraphy Field Notes:
Worksheet #2

ACTIVITIES FOR STUDENTS

- Check if hardness is under 2. ☐
- Use a nail to make a tiny scratch of your rock. Can you see a mark on the rock?
  ☐ Yes ☐ No
- Check if hardness is 5 or greater. ☐
- If you cannot scratch the rock, what other ways can you tell its hardness? _____
  _____
  _____

Color

- Use a magnifier to look at your rock. Describe the color(s) that you see. _____
  _____
  _____

Grain Size

- Look closely at the rock with the magnifier.
  Can you see the tiny particles that make it up? ☐ Yes ☐ No
- Are all the pieces that make up your rock the same size? ☐ Yes ☐ No

  Geologists call same size grains "uniform", and different sized grains "mixed".

Other Interesting Features

- Do you see any fossils on your rock? ☐ Yes ☐ No
- In the Entrada Sandstone, can you find any cross-bedding, or signs of wind blowing sand first in one direction. Then the other? Cross-bedding will look like all the layers slope up in one direction, then slope off in another direction.
  ☐ Yes ☐ No
- How is this rock different from other rocks that you have looked at? _____
  _____
  _____
- Are there any other observations about your rock that you would like to make? _____
  _____
  _____
  _____

Erosion Hike

ACTIVITY PAGE

Age Level

4th through 8th grades

Purpose of the Activity

The purpose of this activity is to give students an opportunity to discover the many forms of erosion taking place on and in the canyons. Colorado National Monument was set aside for protection and preservation in part because of the remarkable erosional features of the canyons and mesas. On a three-mile hike round-trip, students will use methods of scientific inquiry, individual observation and creative recording to document types of erosion that they find.

Amount of Time Needed

Four hours for younger students and three hours for older groups. It is best to plan this to be a part of a day-long experience in the park.

Best Location

This activity has been developed specifically for the Old Gordon Trail at Colorado National Monument. The trail is easy to moderate for hiking and travels across sand, rocks, a wash, and up onto slickrock. Striking views of area canyons, rock formations, erosion, and geology are found throughout the hike. Remember, however, no water or restrooms are available.

Materials

As this hike goes into a distant part of the park, it is important that students be suitably prepared. In addition to good walking shoes and seasonally appropriate clothing, they will need a day pack to carry water bottle, lunch and snacks. Each student will also need the following items:

- ☐ Erosion Worksheet #1: Looking at Rocks.
- ☐ Erosion Worksheet #2: Discovering Erosion and Weathering.
- ☐ Pencil.
- ☐ Clipboard.

Erosion Hike

ACTIVITY PAGE

Background Information

This activity is intended to give students an opportunity to observe, record, and reflect on the different layers of rocks found in the park. They will also see first-hand the way that rocks erode or decay, to become the building blocks for new rocks.

The "Looking at Rocks and Discovering Erosion and Weathering" worksheets are the focus for this activity. They are a place for students to document their observations. Students must record some notes about a rock that they discover along the trail. Their observations and notes will be similar to those that a geologist might make in the field. Worksheet #2 will be used to make notes of places where they see the types of erosion. Using these worksheets, students not only learn terms and concepts of geology, but they get to experience them first hand.

For the teacher/leader, a trail map and list of suggested stops accompanies this activity. The trail is marked with cairns, or small rock piles, to show the route. In places boulders line the trail as well. The information at each stop is intended to spotlight certain places, views, ideas and geologic concepts to the group.

How to Do the Activity

Preparations

Before going on this hike, it is important for the teacher to review some areas of information in this guide. First, look at the "Preparing for a Field Trip" section to get familiar with the park and the things to do to get ready. Second, it is helpful to contact monument headquarters to find out if other schools or groups are planning to be using the same trail on the same day. (This affects parking availability as well as the quality of the experience for all.) Third, arrange for some parents to accompany the group. A ratio of one parent for every five students works well. Fourth, plan your visit to be during the best weather for hiking, usually the months of September, October, March, April, and early May. Other times may also work, but wind, temperature and moisture may make those months less agreeable.

Preview the Trail

As with any field trip, the teacher should preview the trail. It is ideal to do this several days in advance of the trip, at the same time of day that the class will be traveling. While not a requirement, taking this extra time before the trip will give the teacher a familiarity and confidence with the area and material that enhances the experience and safety of the group. If, for example, you discover a great vista from which the rock formations are especially visible, then you will be able to tailor your time on the trail to give an adequate amount at that spot. If the water is running high in the wash, then you will know to have students be prepared to get wet. These details can make the difference between an average and a great trip.

Erosion Hike

ACTIVITY PAGE

Know the Rock Formations

Take time to get familiar with the different rock layers by reviewing the information given in this activity and elsewhere in "The Rocks Before You" part of this guide so that you can correctly identify the Precambrian, Chinle, Wingate, and other units present in the monument. Look over information about erosion so that you can help guide students to see signs of it.

Worksheets and Supplies

Copy off the worksheets in this activity so that each student will have them. An option is to collate and staple them together to form a notebook for the hike. Hope for good weather and enjoy the beautiful geology and erosion taking place around you.

Step-by-Step Instructions

Before You Leave the School

Before you leave the school, remind everyone to use the restroom. There are no flush toilets during much of the year at the Devils Kitchen area, and no restrooms on the trail. Remind students also of methods of handling urination and defecation in the desert. Discuss other "trail etiquette" such as staying together, hiking on the trails and the "No Collecting" policies in national parks and monuments. Make sure everyone has a lunch, full water bottle, snacks, appropriate clothing for the weather, and good walking shoes.

Rules to Remember on the Trail

When you arrive at the Devils Kitchen parking lot or before, a discussion of trail safety is important.

1 Many creatures, from snakes to lizards to scorpions and spiders, take refuge from the hot sun by hiding in crevices and under rocks. Use caution when climbing or picking up rocks. Be able to see the area where you place your hands, toes, and seat.

2 Desert soils are delicate and yet sustain a remarkable variety of life. Please stay on existing trails rather than making your own.

3 Watch your footing. Rocks may appear to be sturdy and strong, yet can be surprisingly weak, loose and dangerous. If one begins to roll down on hikers below you, call out "ROCK!" to alert them to its path.

4 Do not carve on the rocks or scratch your initials into them. This is a violation of NPS regulations as much as being poor trail manners.

5 Remind students of the importance of watching out for one another in the desert. If someone seems to be having a difficult time, offer to carry his or her pack. If someone mentions getting a headache, remind him or her to drink more water. Take care of one another.

Erosion Hike

6 Make sure everyone has their water bottle, lunch, snacks, jackets, hats, and sunscreen, as well as their supplies for the activity, in their pack prior to departure.

7 Due to the confusing nature of the trail, with many small footpaths going off of it, it is imperative that the teacher be the leader. A parent or student teacher should be the last person in line and make sure that everyone has come along.

Stay Oriented

As you head down the trail, be aware of your surroundings. Where is the road? Serpents Trail? No Thoroughfare Canyon? The wash? Observe how the trail begins as a wide path going downhill to a split. You want to stay on the major marked trails, not the little wandering footpaths that go off the trail at many places. Pay attention to this. The trail that you want to follow is described in detail here and is marked with cairns, or small piles of rocks, and is lined with rocks throughout. When in doubt, look for a cairn.

Introduction

Gather at the trail map/sign. Begin by saying that today you will be going on a three-mile round trip hike into a remote part of the park on Old Gordon Trail. The purpose of the hike is to learn about the many forms of erosion taking place in the area, and to learn more about its role in creating rocks too. Each student has a set of worksheets that need to be filled out as the hike goes along. As you walk, try to notice the different colors and textures of the rocks that you pass. Can you match any with the formations listed in your worksheet? The teacher should pick up a rock and use it as an example. Note its color, texture, grain size, and location in relation to other rocks. Can you guess what type of rock it might be? Then try to find signs of how it has eroded or broken down from a larger rock.

Hike down the trail until it splits in two.

Stop #1: The First Trail Split

Going right takes you up No Thoroughfare Canyon. You will take the left fork, which is Old Gordon Trail. Stop at the split.

At this stop, and down toward the wash, you have good views up No Thoroughfare Canyon. Point out the dark, slate gray color of the rock up in the canyon. This Precambrian formation underlies Colorado National Monument and is one of its unique features.

The combination of erosion, seasonal flooding, and floods due to storms has washed boulders of many sizes down the drainage. These black to gray rocks, some beautifully laced with pink and white crystals, may be seen along the trail. They show evidence of two powerful but silent forces at work, metamorphism and erosion. Encourage students to record some of these rocks on “Erosion Worksheet #1.” You will see many of them between here and the wash.

Notice, also, the outcrop of whitish-red rock to your left. It is a useful landmark. You can use it to underscore how layer upon layer of sand, silt, mud, decaying vegetation, and other materials build up. The pressure of these layers, one on top of the other, is instrumental in the creation of sedimentary rocks from sediments.

Erosion Hike

ACTIVITY PAGE

Stop #2: The Wash

Whether the wash has water or not, stop here for a few moments to notice the change of temperature and humidity you experience. Observe how the vegetation is different. (Leaves are larger, cottonwood and willow trees grow along the water's edge, and plants are closer together.) Look for signs of animals coming down to the water. Coyote, fox, deer, mouse, rabbit, and even domestic dog tracks may be found (although dogs are not supposed to be here.)

If water is flowing, look for places where it moves quickly or slowly. Talk about how water affects the local topography, aiding in the breakdown of rocks into tiny pebbles, washing grains of sand downstream to new locations, where someday they may reform into new rocks. Notice where the current moves and how it goes faster in some places and slower in others. How would this affect the surrounding rocks? What would the effect be from the standpoint of erosion?

If the wash is dry, spread out along its banks and notice places where there are large rocks and places where there are only sand grains. Observe the cliffs where the force of water undercut the banks and caused them to wash away. Look for places where the water was quiet, such as the downstream side of large rocks or on the edges of the creek. These are places where sand grains were deposited and built up. See if you can find signs of the high water line on the opposite bank. Ask students to find more evidence of erosion breaking down the Precambrian rocks and carrying them away.

Get out "Erosion Worksheet #2" for the next part of the hike.

Cross the wash and head up onto the hill on the other side. Be careful to stay on the boulder-lined path, and not to stray onto the side paths that take you over to the park service boundary line and fence. Remind students of the no collecting rule. It is very tempting here.

Stop #3: Among the Junipers

Climbing up the ridge, you pass through Utah junipers and pinyon pines. Junipers have scales that clasp around the branches and blue berries. Pinyons have short thick needles and cones. Look for signs of tree roots causing physical weathering as they've grown into cracks in the rocks. Humans cause another type of erosion. As they hike, their footsteps make the trail deeper and wider. Soil in this area is fragile and dry, easily damaged by human wanderings. Thus it is important to stay on the trail to minimize our impact. Can students see the "rut" that is developing as the trail?

Look to the north, toward Grand Junction and the Book Cliffs, for a third type of erosion: where water in the wash has undercut banks and carved cliffs as it helps to carry sediments downstream.

Have you seen any of the Precambrian boulders lately? No. That is because you have moved onto a different kind of rock formation, one that is above, and younger than, the Precambrian. Look at a rock. Feel its granular texture. Can you imagine what kind of an environment existed long ago to create a rock with such a coarse, sandy quality? You can make another rock identification on your worksheet here.

Erosion Hike

ACTIVITY PAGE

Stop #4: Slickrock

As you leave the trees and cross the slickrock, watch carefully for the boulders lining the trail and follow the cairns up the ridge. This area is a good place to rest if it is not too hot. The class can spread out on the rock and enjoy the view. Do not let students wander too far to the west, as there are steep cliffs dropping off. Remind them also to drink plenty of water as they travel across this dry ridge.

Examine the lichens that make colorful, crust-like patterns on the rock. Lichens are a combination of a fungus (which gives the lichen its structure and means of reproduction) and an algae (which makes it possible for it to create sugars and photosynthesize). As they slowly grow, lichens secrete a mild acid, which helps to break down the surrounding rock. Their rooting structures, known as rhizomes, penetrate the surface of the rocks, further contributing to its weathering. For these reasons, scientists consider lichens to be valuable pioneers in the creation of soil. Can you find a large lichen and see any of the effects that it has had on its rock host?

Follow the cairns and boulders along the trail upward along the ridge. As there is little shade in this next one-half mile, use caution on hot days. Watch how the sandstone has different features and colors in this section. Some places it is white, others yellow; in some spots it is smooth, others flaky or knobby. Can you tell what might make for such differences?

When you come to a large dead tree, the trail turns east.

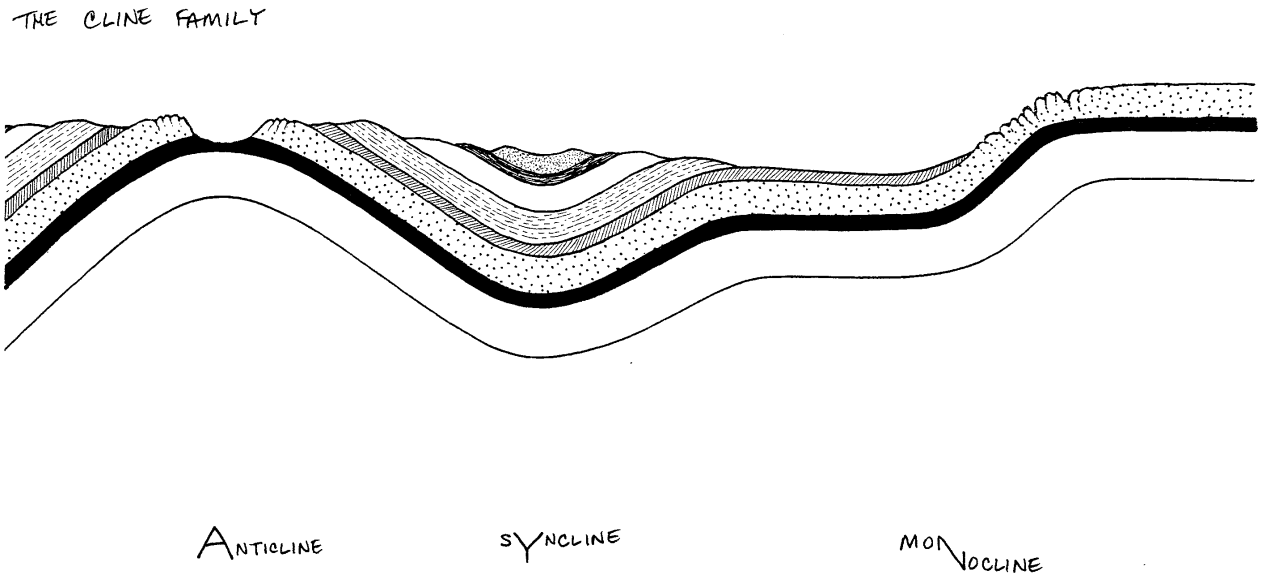
Stop #5: The Old Road

As the trail gets higher on the ridge, it turns south. You will become aware of how the path widens and takes on the quality of a road. This is the Old Gordon Trail, the remains of a private toll-road built by pioneer John Gordon in the early 1880's. According to the National Park Service, this road gave people access to logging camps in the high country. As the class walks along it, think of all the people who have preceded you here, stepping where you are, perhaps leading a mule loaded with supplies, or hauling down timbers from up on Black Ridge. Can they find any other signs of other people passing here?

Farther up the road, find a place where the group can sit down with good views to the east. This is a good place to have lunch or a snack.

Erosion Hike

ACTIVITY PAGE



Stop #6: Erosion at Work

After a rest, get out the worksheets on erosion and review the findings thus far. As the class is sitting on the mesa, many erosional features are visible. 1) The drainages to the west and east, though full of water only seasonally, carry enough water to be deepening and widening these two canyons. 2) In the little drainage to the east, Echo Canyon, look for joints in the rocks where freezing and thawing can loosen boulders and cause rock falls. 3) Notice the difference in caprock and the softer rocks below it on the colorfully banded hillside across the canyon. Which will erode more quickly, the brown cliffs at the top of the hill or the gray rocks below?

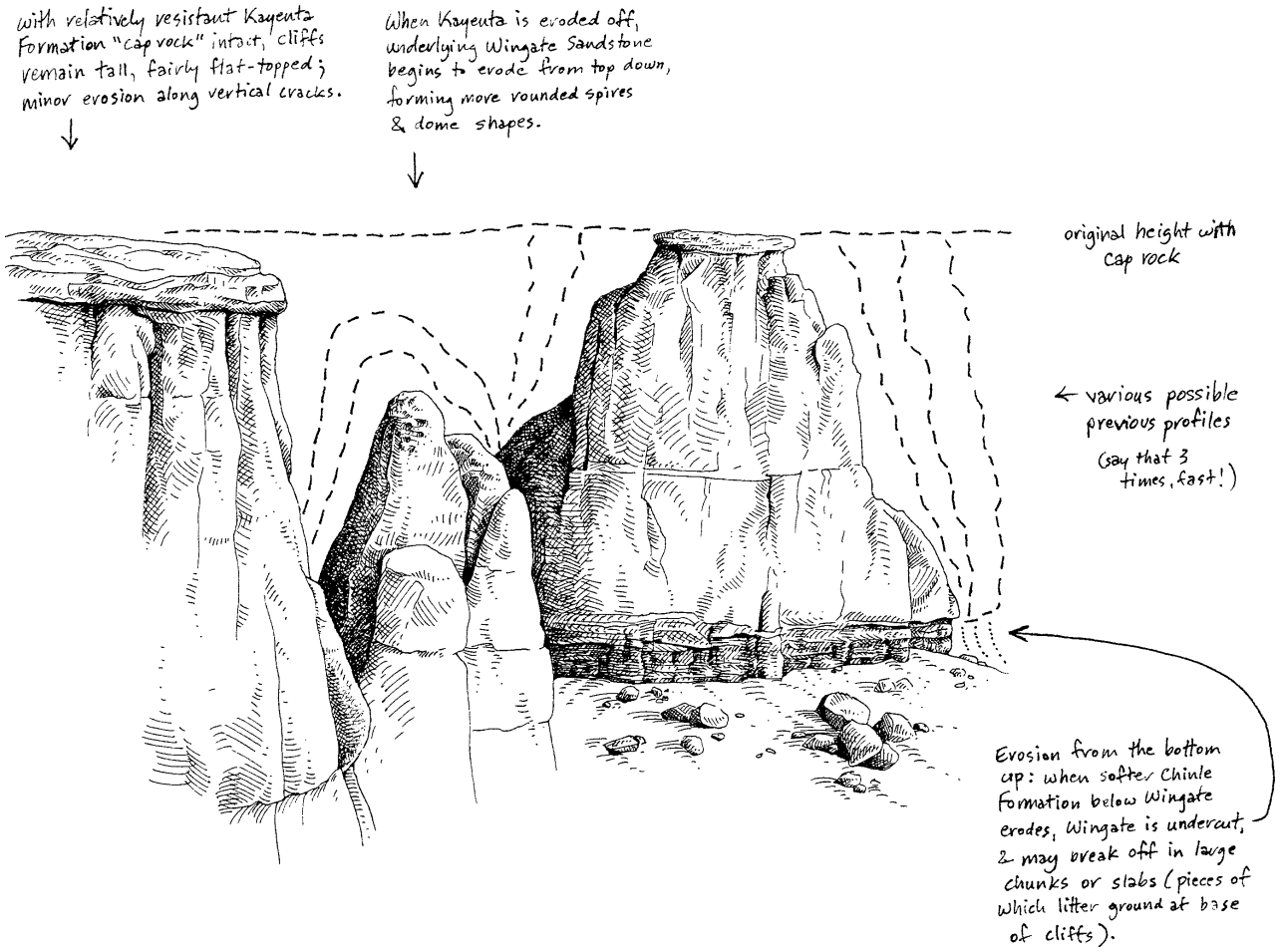
Ask if anyone can identify which formation the gray rocks are a part of. If the students answer the Morrison, they are right. What kinds of fossils are famous for being found in the Morrison Formation? How could you go about finding one, based on information about erosion that you have learned today?

From this point, the trail continues on approximately one-half mile further, heading up the pinyon and juniper-dotted mesa. If you have time, continue on up the trail. If not, return the same way that you came. Again, pay close attention to the locations of cairns. Going downhill can be more difficult than many people think, so give a few words of advice to the class before taking off.

1) The knees act like brakes for the body on the downhill and thus must work very hard. Speed is not appreciated by them.

Erosion Hike

ACTIVITY PAGE



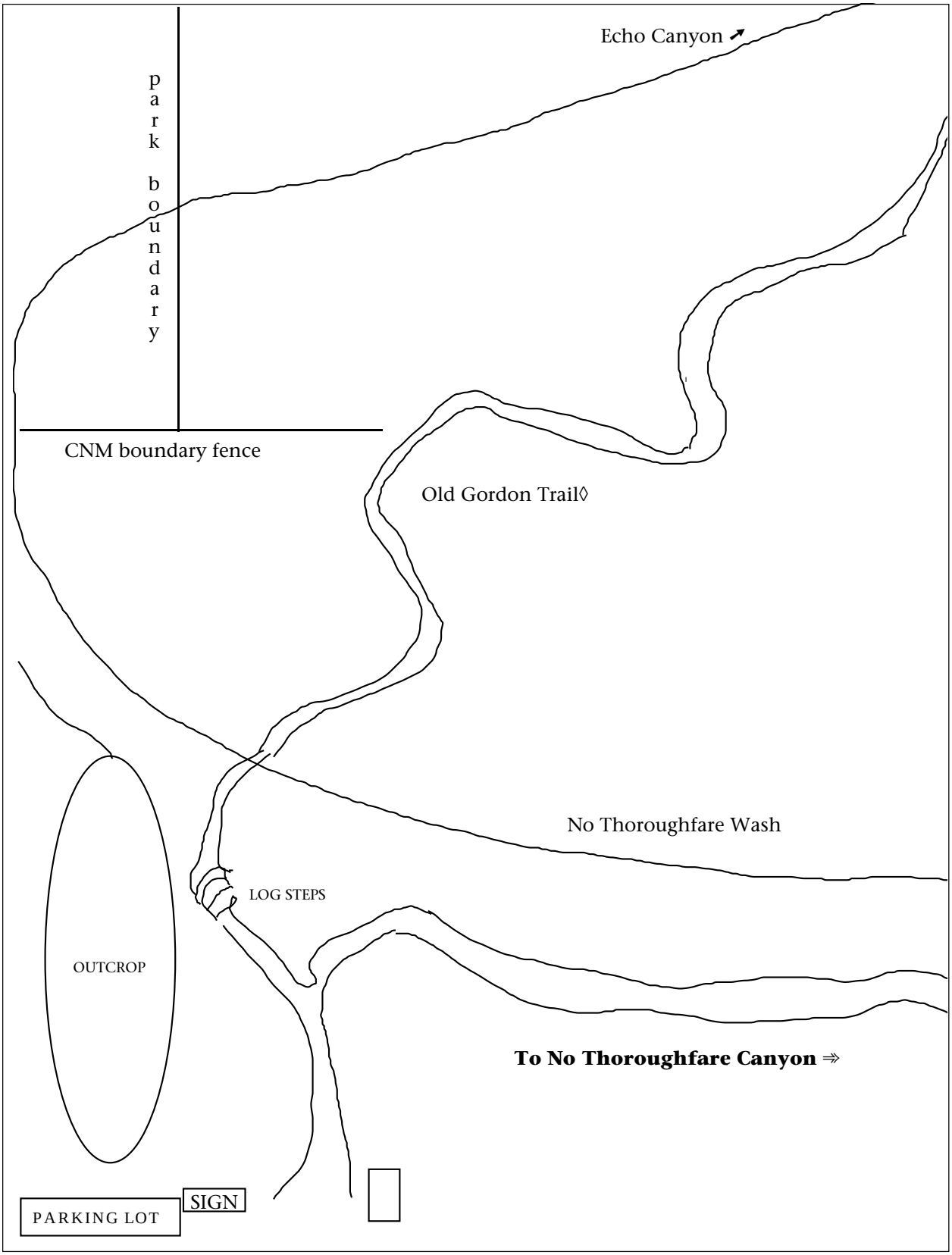
2) Slickrock is exactly what it says it is, slick. Walk carefully on it and pay attention to your foot placement. Little rocks and gravel can mean that you slip very easily.

3) Due to the importance of finding the trail on the way back, the teacher will be the leader.

Conclusion

Through observation, inquiry and recording, students have learned about the different forms of erosion. Since erosion has such an important role in both the removal of weathered rocks and the creation of the landscape, it is a force of nature to be appreciated. Through awareness of its role, students may be able to better understand why Colorado National Monument has been set aside for protection as a national monument.

Erosion Hike



Erosion Worksheet #1
Looking at Rocks

ACTIVITIES FOR STUDENTS

Find a rock that interests you along the trail. Look at it closely, feel its texture, note its colors and other interesting features. Make a record of your rock on this paper by answering the following questions. **Remember, no matter how special or unique your rock discovery, you cannot take it home. The national parks were established to *"PRESERVE AND PROTECT"* natural and scenic resources in perpetuity. That means forever...so your children's children's children— and so on — will be able to come to places like this and share your experiences. So LEAVE THAT ROCK, but make a record of it on this paper! Come back to visit your rock any time.**

1) **How big is your rock?** Bigger than your hand? your backpack? a car? Smaller than your fingernail? Think of something to compare it to in size.

_____

_____

2) **What color(s) is your rock?**

_____

3) **What does your rock feel like?** Describe its texture. Sandy, sharp, knobby, smooth, or ?

_____

_____

4) **Does your rock have any interesting things on it**, such as fossils, crystals, ripple marks, lines, colors or patterns? If yes, please describe.

_____

_____

5) **How hard is your rock?** Scratch it with your fingernail. Can you see a mark? If so, your rock is soft. Try scratching it with another rock. Can you see a mark now? If so, it is medium hard. If you still don't see a scratch, it is a very hard rock. Check the answer that best describes your rock.

My rock is: ☐ soft ☐ medium hard ☐ very hard

6) **Do you know the kind of rock that you have found?**

_____

7) **Can you see another rock, or rock formation, nearby that matches the color, hardness, and texture of your rock?**

_____

8) **How do you think that your rock came to be where it is?** Can you imagine the chain of events leading to your rock's arrival at this place? What type(s) of erosion or weathering might have brought it to this point? Which would cause it to move to where you found it? Wind, water, heating, cooling, freezing, drying, flooding, gravity, animals, plants, or humans?

_____

_____

_____

9) **For your record, sketch your rock, or describe it with words, on the back of this page.**

Erosion Worksheet #2
Discovering Erosion and Weathering

ACTIVITIES FOR STUDENTS

All around you the land is wearing away, going from high to low, peaked to smooth. This never-ending cycle is known as **erosion**. In erosion, material is **moved** from one point to another by the action of water, wind, or gravity. **Weathering** is one part of the erosion process. It is the wearing away of rocks exactly where they sit. No movement is involved. Thus, a rock that is washed down a stream is eroded, but a rock that cracks open but does not move anywhere is weathered.

Listed below are ten different ways that erosion and weathering work. On your hike, look around you. Can you find a place where the rocks have been carried away because of flooding? Can you locate a rock that is weathering in place due to the heat of the sun? Each time that you discover an example, use a few words to record your findings in the spaces on the sheet. Feel free to use the back of the sheet too. You do not have to see water at work, or frost in action. Just describe the places where you see **signs** or **effects** of these types of erosion occurring. Good Luck!

1) Running water in streams or drainages moves small rocks and pebbles to new areas.

_____

_____

_____

2) Running water undercuts banks, breaking off softer rock or soil, and carrying away the loosened material.

_____

_____

_____

3) Flash floods and summer downpours deposit large boulders in unexpected places, some even long distances from streambeds.

_____

_____

_____

4) Wind blows loose sand around and around in a crevice, eventually creating a hole in a rock.

_____

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_____

5) Rocks fall off a cliff, pulled downward by gravity, and create piles of rubble and boulders (called talus) on the slopes below. Sometimes you can see the place from which the rock fell as a patch of clean, pale, or white rock on the cliff above.

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Erosion Worksheet #2
Discovering Erosion and Weathering

ACTIVITIES FOR STUDENTS

6) Sun heats up the surface of a rock causing the outer layers to expand and crack. The inner rock stays cool and does not heat up. The result is exfoliation: thin layers of rock peel off on the outside or top of the rock.

_____

_____

_____

7) Moisture gets into cracks in rocks. When it freezes, the moisture expands; when it thaws, it contracts. This alternating cycle loosens grains of sand, widens cracks to grooves, and eventually breaks off whole slabs of rock.

_____

_____

_____

8) Lichens, a combination of algae and fungi, grow in colorful crust-like patterns on rocks. They secrete a mild acid that causes the surface of rocks to soften, and break up into tiny pieces. They also cause cracks in some rocks.

_____

_____

_____

9) The roots of trees or plants act as wedges, widening and deepening spaces in the rocks as they grow.

_____

_____

_____

10) Humans cause erosion by wandering off trails, breaking down soils and soil crust, and making new paths across the desert. As our footsteps scrape across the surface of rocks, each passage deepens trails. Among the most damaging forms of erosion caused by humans are initials or symbols carved on rock. Called graffiti, these diggings and scraping on rocks can have ugly, as well as harmful, effects on the rocks. List one or more forms of erosion caused by humans that you find along the trail.

_____

_____

_____

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Age Level

4th grade and up.

Purpose of the Activity

Maps are useful, if not essential, tools in the city as well as in nature. One of the best ways to learn about using maps is to make one. In this activity, the class makes two different kinds of maps: a classroom map and a topographic map. Then, they explore the features of maps and the techniques of map-making by creating a third map, this one of the Grand Valley as seen from Colorado National Monument. Reading, geography, mathematics, and art skills are all utilized.

Amount of Time Required

The classroom map and the topographic maps each take forty-five minutes to complete. Because the mapmaking activities are self-contained, it is easy to do one map at a time, even different maps on different days.

Best Location

The classroom map and topographic map activities are most easily done at school. Both may be incorporated into a longer map-making session held on a field trip to Colorado National Monument.

See *Extensions* for information about this alternative.

Materials Needed

For the Classroom Map:

- ☐ Paper and pencil for each student.
- ☐ Rulers for each student, and a tape measure (optional).
- ☐ Variety of maps for reference.

For the Topographic Map:

- ☐ Washable markers with fine tips — 3 per team of students.
- ☐ Ruler — one for each team of students.
- ☐ Topographic maps for reference. A topographic map of Colorado National Monument, entitled *Colorado National Monument: Topographic Map and Hiking Guide*, is available at the monument Visitor Center. It will be a helpful resource for this activity, even though it includes different information from a United States Geological Survey (USGS) topographic map. As a result, you may also want to have a 7.5-minute USGS Colorado National Monument Quadrangle topographic map for reference in this activity. If that one is not available, any other USGS maps will still be usable. Topographic maps are available for purchase at local outdoor gear and sporting goods stores.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Background Information

Maps are a useful part of everyday life. They take many forms, including mental maps, city, land, world, as well as constellation maps. Pollsters, census takers, economists, entrepreneurs, pilots, planners, architects, astronomers, weather reporters, recreationists, as well as geologists utilize maps. With the help of maps, political as well as personal boundaries are drawn. Decisions about everything from military actions to fence lines between neighbors, to right-of-ways along roads, to the fastest route between two places, are made with maps.

Your mind, too, is full of maps. When you walk through your room in the dark, your mind holds an image of where the bed, the bureau, the chair, the wastebasket are situated. That way, you do not stub your toe on the way to the light switch. As you hunt for your keys, homework, or backpack, your mind re-runs a map of where you were earlier, in order to help you locate what is lost. Packing a suitcase for vacation at the beach, you bring different clothes than you do to go camping or sledding. This is because your brain projects a map of the conditions that you will experience in this new location. Maps, big and small, make life a lot better for us all.

Definition of a Map

What is a map? Dictionaries define maps as representations of places on flat surfaces. In other words, maps attempt to show a three-dimensional site, such as a canyon, within the limits of a two-dimensional piece of paper, rock, skin, or patch of dirt.

Earliest Maps

No one knows when or how the first pathfinder used a stick in the dirt to draw a route for his or her people to follow. Still, for thousands of years, maps have conveyed important information about navigation, taxation, and location of natural resources. Directions to water holes, hunting grounds, trade routes, ocean currents, sacred grounds, as well as the homes of friends and loved ones, have been given with maps. One of the oldest maps known is from 4000 years ago. It was made on a slab of clay by the Babylonians. Early Egyptians designed maps as way of determining property lines for the purpose of taxation. The remarkable array of maps for exploration of the oceans and continents reflects the importance of maps throughout the Middle Ages and Renaissance. In our modern era, satellites help us pinpoint our own or another's location to within a few feet. This accuracy in mapping opens up entire new dimensions and opportunities in the way that people can use maps.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Viewpoint

Maps come in many shapes and sizes. The purpose of a map will often dictate its form and **viewpoint**. A map of the floor of the ocean might look at features from above, looking down and in. If one is following a path through the mountains, the orientation may be at ground level, with the landforms on either side. A chart of the night sky is designed for the reader to be below, looking up. Most maps use a **bird's eye or aerial view** for their reference. When referring to any map, the reader should note the viewpoint to be able to follow the map successfully.

Scale

Scale is another facet of maps. It is impossible to make a map as large or deep as an ocean, or as tall as a mountain. Therefore, everything must be made smaller proportionally to fit on a piece of paper. For instance, one inch on the Colorado National Monument 7.5-minute map equals 24,000 inches of space on the **ground**. Another way to look at this is that two and one-half inches on the map represent 60,000 inches (about one mile) of land. Scale is usually expressed as a ratio, such as 1:24,000. The ratio states a relationship between the two parts, with one unit on the map representing 24,000 of the same units on the ground. Every map has a notation of its individual scale for reference. The scale may be in a variety of sizes from miles to centimeters. Thus, it is important to pay attention to the amount shown in the scale since it varies from map to map. On topographic maps, the interval of the contour lines is given with or near the scale, another valuable detail to remember when reading or making maps.

Legend

Another feature of maps is the **legend**. It lists all the different symbols, lines, and colors on the map, and explains what each one means. If you look at a state map of Colorado, for example, the legend shows that the wide lines are interstate highways. The narrow lines represent state highways and the fine double lines are unpaved roads. In contrast, lines on a topographic map have an entirely different meaning: they indicate elevation changes, and show the contours of the land. Careful reading of the legend on the Colorado National Monument map may make the difference between traveling on a constructed trail (dashes), or an undeveloped route where you must pick your way along a drainage (dots). Therefore, it is important to check the legend on each map to be sure that you are accurately interpreting what is depicted.

Grids

Grids are often seen on maps, dividing them into equal segments. Time zones, longitude, and latitude are familiar grids on maps. Tourist maps often use a grid system of numbers and letters to help locate attractions quickly and easily. On many topographic maps the latitude and longitude are given in the corners of the map.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Township and Range Grids

Because so many people use public lands in the United States, a grid system called **township and range** is projected onto many land maps. This method of viewing the land was first developed in the 1800's as lands west of Ohio were explored for the first time. In order to incorporate new lands into the United States, a standardized method of surveying the new territories had to be developed. As a result, longitude and latitude lines became the basis for dividing the land up into smaller, more manageable segments. These segments measured six miles long by six miles wide. Those that were north or south of specific latitude were called **townships**. Those that were east or west of a given longitude were labeled **ranges**. Once the components are understood, the uniformity of this grid system makes it easy to read any land map of the United States. For the purposes of classroom map reading, knowing that the north and south lines determine the township, and that east and west lines determine the range, is adequate. Township is stated first, followed by the range. Thus, Colorado National Monument is part of Townships 1 N (North), 11 S (South), 12 S (South), and Ranges 102 W (West), and 101 W (West).

Section

The six-by-six mile townships are further divided into thirty-six smaller **sections** usually one mile square. The sections are organized one atop the other for ease of identification. They are numbered consecutively in a continuous line from number one to number thirty-six, beginning in the upper right-hand (northeast) corner, and ending in the lower right-hand (southeast) corner. Thus, anyone buying, selling, working, or recreating on western lands can easily determine where they are, down to a one mile section. Often sections are divided into quarter sections for more specific details. While it takes practice to get comfortable with, the grid system of township, range, and section is so widely used that it is very worthwhile to learn.

Since each map has a structure and features that make it unique, learning how to use them can be a challenge. However, because map reading can get you safely to the place you want to visit, or save you from getting lost, it is a valuable skill to develop. In the following activities, students will investigate how maps are made, while developing their map-reading abilities. Educational content standards are also met with these activities.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

How to Do the Activity

Preparation

Before you begin the first map-making activity, gather the materials that you will need. Take a good look around the classroom. Where are the desks? The bookcases? The chalkboards? The pencil sharpener? Note the locations of the doors and windows in the room. All these details are included in the maps that your students will make. You may want to sketch a map of the room for your reference and for comparison with the student maps.

Next, review the information about topographic maps in the "Let's Get Oriented" activity. Practice making the topographic map on your hand or someone else's, so that you will be able to draw and demonstrate the contour lines with confidence. Make sure that you are familiar with the elements of topographic maps, and that you can comfortably read and explain one.

Lastly, if you are going to make the map of the Grand Valley, plan an advance visit to the site from which the map will be made so that you can be familiar with the vista. Find different landmarks to give to students to pick out. Such preparations will make these challenging activities successful.

Not All Students Are Mapmakers

A word of advice: Not all students are mapmakers or comfortable in the role of artist. These individuals will need assistance and encouragement to "see" as a mapmaker does. Often, just the change of perspective from human scale to aerial is difficult to accomplish. Be patient with these children, and give everyone lots of positive feedback. Extra parental or chaperone support is very helpful in this activity. If you know of a student who may need extra assistance with this activity in advance, you may want to assign him or her to work in a team with another student, or link the student with the adult.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Introduction to Mapmaking: The Classroom Map

Map #1: Introduction to Mapmaking: The Fly on the Ceiling

Step One: The teacher may want to have several different types of maps hanging up in the classroom and available for students to look at as part of this activity. Begin by asking the class who has used a map before. On the chalkboard, list different kinds of maps that the students know. Atlases, globes, road maps, state maps, constellation maps, and treasure maps are just a few of the maps with which they should be familiar. Others to mention are property maps (for taxation and real estate), architectural maps (for building designs), and mental maps (knowing by memory where to go to find milk at the supermarket). Of course, you want to mention geologic maps that are used to study rock formations, and to search for such valuable commodities as oil, gas, coal, and precious metals.

Next, find out what the students think are the important parts of a map. If they do not mention viewpoint or scale, explain these terms to them. Discuss how a map is a two-dimensional representation of three-dimensional place. To illustrate that concept, ask them to draw a picture of their neighbor's face (three dimensions) on a piece of paper (two dimensions). As they attempt to do that, describe how the mapmaker's challenge is to represent a mountain or canyon on a mere piece of paper.

Step Two: Draw a map of the classroom. The purpose of this activity is to acquaint students with the concept of "viewpoint". Students are to make a map for a fly that is stuck on the ceiling of the classroom. The fly is very hungry, and needs something to eat. It is looking around the room from high above, hoping to find an apple, a sandwich, a cookie, or some crumbs that a student left behind. Therefore, the students' maps should be made to assist the fly in finding food. The viewpoint should be as if the student mapmaker were the fly looking down from the ceiling. Features of the classroom should be drawn in, including the doors, windows, bookcases, desks, wastepaper basket, and so on. Of course, somewhere on each map, the mapmakers should hide a piece of food for the fly.

Begin the map by drawing an outline of the room, and marking the directions north, south, east and west on it. Next, add windows and doors. If desired, different colors or symbols can be used to label desks, bookcases, and other features of the room. Only when the map is complete, should the food be hidden somewhere. If students have trouble thinking of places, give them suggestions such as gum on the trash can, an open lunch box under a desk, the teacher's cup of coffee or tea on a desk. Encourage the class to think of this project as making a treasure map - for a fly. As the class works, the teacher should assist with any questions that come up. If a student has difficulty with viewpoint, adapt this assignment for the student's abilities.

Step Three: After 15 minutes, ask students to give their maps to a friend. This person will be the fly, and must use the map to find where the food is hidden. Exchanging papers gives the mapmakers a chance to see how other people drew maps, and to learn tips for future efforts. After the "flies" have found their food, discuss what the students learned about making maps. If there is time, ask students to make a **legend** for their maps to show the different elements of their map.

A fun addition to this activity is for the teacher to hide a snack in the classroom for the students. The only way that the treat can be located is by using the aerial viewpoint that a fly would.

Optional Activity

Determining the Scale of a Map

Step Four: *This is optional*, and focuses on **scale**. Depending on how well students understood the element of viewpoint, and on their math skills, this is a useful step to incorporate. Get out rulers and use the back side of Map #1 for this exercise. First, students measure the length and the width of the room that they drew in Map #1. On the back side of the map, they should record their findings. Next, the class should use a tape measure to determine the length and width of their classroom. The students should also record these numbers on their worksheets. Together, these notations will be used to calculate the scale of Map #1. Alternatively, the class can find the scale together.

The class will benefit by using one student's notes as a sample for calculating what the scale of Map #1. Remember that scale is presented as a ratio: one unit on the map equals so many of the same sized units on the ground. Thus, if the student's map size is in inches, and the real room size is in feet, the room size must be converted to inches for the ratio to work.

A sample worksheet might look like this:

Pat's Map

Length of room in Map #1 = 8 inches
Length of Classroom = 10 feet 6 inches (Conversion) = 126 inches

Ratio of Room to Classroom
8-inch room map: 126-inch classroom
1-inch room map: 15.75-inch classroom

Therefore, ***scale*** *of map is 1:15.75.*

(Note: No one answer will be correct for this activity. Because each classroom map will be a different size, the ratio will differ slightly for each student.)

Through Map #1, "The Fly on the Ceiling", students will learn about key elements in making and reading maps: viewpoint, legend, and scale. They will appreciate the complexity of the job of mapmaker, as well as to understand about the mapmaker's tools. In the next exercise, they will learn about another kind of map: the topographic land map.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Map #2: Making Topographic Maps Using Your Fist

Map #2: Making topographic maps[1]

Step One: Introduce this activity by asking if anyone has ever gone hiking or camping and used a topographic map. Show a topographic map to the students. In what ways does the topographic map seem different from the state map? Encourage students to notice the colors and the squiggly lines, called **contour lines**, on the topographic map. Explain how contour lines work with information from the "Let's Get Oriented" activity, later in this chapter.

Step Two: In this activity, students draw on their partner's hands to illustrate the concept of making topographic maps. Remember to use washable markers. Divide the group into teams of two. One person draws while the other is "the map". Later, roles will be reversed. The person to be mapped, hereafter referred to as Mapmaker A, makes a fist. Keeping his/her arm straight, he/she places the fist palm down near the edge of the desk. The fingernails and palm should be as flat as possible against the desk. (Note: Different hands make different fists. Some will prefer the thumb inside the fingers, others will not. What matters is not the placement of the fingers, but the ability of A to hold the fist position steadily flat against the desk for the time it takes the map-maker to draw the map.) For ease of reference, the fingers should be labeled #1 (thumb) to #5 (little finger).

Step Three: The person making the map, hereafter referred to as Mapmaker B, needs to look closely, preferably at eye level, at the fist. The different lumps and bumps, lines and ridges covering A's hand should be noted. Then, B should find the 1/4-inch mark on the ruler. Placing the ruler next to the #1 finger (thumb), B should make a series of dots *all exactly 1/4 inch up from the desk* around to the next finger. **It is important to keep the marker straight out from the 1/4 inch notation on the ruler to assure that the dots are the same distance from the surface of the desk all the way around.** This is a very important feature to stress, as mapmakers draw contour lines with precision. Each one represents an exact elevation above sea level. In this exercise, contour lines should be measured with a ruler to be exact distances from the desk. After all measurements of the fingers are completed, the dots/lines should be extended around the hand to the wrist.

Step Four: When the first series of dots is complete, Mapmaker B should carefully draw a line to connect them. With the first contour line now finished, a new color of marker should be chosen for the second contour. Repeat the procedure, using the 1/2 inch notation on the ruler this time. Make dots around the fingers and hand to the wrist. If it is easier to make the line directly, go ahead and do so. Continue around the fist, making sure the dots are *exactly* 1/2 inch above the surface of the desk. When these are connected, repeat the dots a third time with a third color of marker. With each new line, move up 1/4 inch on the ruler. Make more contour dots and lines around the fist until the knuckles are reached.

Pay attention to the indentations between fingers. Make the lines go continuously all the way into and through those spaces rather than jumping from finger to finger.

[1] The concept for this activity comes from *Earthsearch, A Kid's Geography Museum in a Book*, by John Cassidy. Klutz Press. Palo Alto, CA. 1994, p. 46.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Remind students to make the lines with the marker as straight as possible from the ruler. The result will be that some lines are closer to one another than others. This is all right, because mapmakers know that each contour line is a specific distance from the base measurement of sea level, and not specific distances from each other. Topographic maps show just this feature when contour lines are wide apart on flat areas and close together on cliffs and steep places. In the context of the topographic map on the fist, the flatter places will be on the hand and wrist, therefore the lines farther apart. On the steep "cliffs" of the fingers, lines will be closer together.

Step Five: When you reach the knuckles, notice how one or two of them are taller than the others. Complete the lines around all but the tallest knuckle. Finish the "map" by making a **benchmark symbol** on the topmost knuckle. Surveyors routinely place benchmarks at sites where they have made a permanent calculation of the elevation. These can be found atop mountains, deep in canyons, even on buildings in the heart of the city. The mapmakers may create a benchmark of their own choosing to place on the highest point of their topographic map of the fist.

Step Six: Change roles so that Mapmaker A may now draw contour lines around Mapmaker B's fist. When the class has completed all the topographic maps, ask students to lay their hands flat on their desks. Notice how the lines are closer together in some places, and farther apart in others. Then make a fist again. Where the hand is flattest, the lines are widest. Where the fist was steepest, over the fingers, the lines are closest. These contour lines mirror those made on the topographic map! That's how a topographic map is made.

Step Seven: Bring out topographic maps from Colorado National Monument and other areas. Lay them out, and let the class gather around them. Ask the students to point to steep areas (where contours lines are close together) and flat areas (where contour lines are wide apart) on the maps. Where contour lines change from close to wide, what does that mean happens to the land? Review any other questions that the students have.

Some advice for making the contour lines on hands legible:

~ Be sure hands are completely dry before beginning the lines.

~ Go slowly when connecting the dots or making the lines. Follow the shape of the fingers, going in and out of the spaces between.

~ Alternating colors helps the mapmaker to keep track of where she or he is.

~ Hold the ruler very still and straight, but feel free to move it from finger to finger and around the hand. Carefully keep the marker level with the 1/4, 1/2, or 1 inch notation on the ruler.

~ It is helpful for students to see a demonstration of what they will be doing. The instructor may want to make a sample topographic map on the fist of an obliging student.

Contour lines represent intervals of 10 or 20 feet on most maps. They must be precisely measured to give accurate data about elevations. Try to be as exact about your measurements as you can.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Conclusion

By making a map of the classroom, and by drawing a map on their hands, students will learn the elements of mapmaking. These skills will enable them to better read and appreciate maps that they may use in and out of the classroom.

Extensions

Map #3: Mapping the Grand Valley

This map can be done alone or in conjunction with the previous two maps, the classroom map and the topographic map. The purpose of this activity is to allow the students to integrate the elements of mapmaking that they have learned about previously into a map of their own. Vistas from Colorado National Monument are ideally suited for this activity. Not only are they dramatic and beautiful, but the clarity of the air and the width of the view make them striking places for mapping the lands below. Above all, being high on the mesa looking out and down gives young mapmakers an already established viewpoint from which to work. They are much like golden eagles soaring high above the canyon rims and looking down to the valley below. (Or, they are like that proverbial fly on the ceiling!)

The best location for this activity is the Historic Trails turnout, off Rim Rock Drive, above the West (Fruita) Entrance Station. This turnout has room for a bus or group of cars, and has excellent vistas of the Grand Valley, the Book Cliffs, Colorado River, and beyond. Alternative sites include Saddlehorn Campground, Canyon Rim Trail, Window Rock Trail, Book Cliff Shelter, or Grand View turnout on Rim Rock Drive. Even the porch area at the Visitor Center could be used for this mapmaking activity.

For the map of the Grand Valley, the following materials are needed.

~ Paper, pencils, and colored pencils for each student.

~ Clipboard for each student.

~ Binoculars will be helpful and inspirational for these maps.

~ Parent chaperones are highly recommended for this activity, both to aid with the mapmaking and group management in the turnout area.

Plan for approximately thirty to forty-five minutes to complete the map.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Step One: Before you begin, make sure that students each have a clipboard, a piece of paper, pencil, and colored pencils. Upon arriving at the Historic Trails Overlook or another site that you chose for this activity, stress safety to your students. Ask them to watch out for one another, since they are in a parking area, just off a road where people are sight-seeing, and near the edge of the canyon. Danger, however, is minimized since the activity takes place at a fenced overlook that is a short distance from the road. If there are students for whom travel on unpaved or uneven surfaces is not possible, there is plenty of space for the class to do the activity from the sidewalk.

Step Two: The purpose of this activity is to make a map of the Grand Valley. Review what the class has learned so far about maps, namely the importance of viewpoint and scale. Here, along the cliffs of Colorado National Monument, they are able to have a bird's eye view of the valley below. This is the way their maps should read—from above looking down.

Step Three: Take five or ten minutes to look around. Let people call out the areas and places that they can identify. Ask students to find: Interstate 70, railroad tracks, the Colorado River, the Book Cliffs, the Fruita Bridge, McDonalds in Fruita, Broadway or Highway 340, Dinosaur Hill, the West (Fruita) Entrance Station, Rim Rock Drive, etc. Afterwards, let students spread out around the overlook to find a place where they would like to work. Explain that they have 20 minutes to design a map of the Grand Valley. Encourage students to do the outlines and placement of sites with pencil, and do the coloring later. The teacher and chaperones can rove among the class giving ideas and advice.

Be aware that mapmaking is not for everyone. No matter how hard they try, some people have difficulty translating what they see in real life onto the smaller scale of paper. For these people, suggest that they draw or write about something that interests them that is located nearby. They may not wander around.

Progress on the maps will vary. For those who finish quickly, get them to color in their maps. Remind them to make a legend of all the different colors or symbols that they have used. This can go on the back of the paper or in a lower corner. Also have them make a scale for the size of their map, and design a directional symbol or compass showing the direction from which to read the map.

Mapmaker, Mapmaker, Make Me A Map

ACTIVITY PAGE

Extensions

Ways to Adapt Mapmaking Activities

1 All activities can be done by those physically challenged. The area at Colorado National Monument is accessible for wheelchairs. Restroom facilities are available at the monument Visitor Center and Saddlehorn Campground.

2 Turn the "Fly on the Ceiling Map" into a maze, by having a specific destination for the fly to reach, a peanut butter sandwich on someone's desk, or the door to the principal's office.

3 Younger students will enjoy making maps as much as older students. For them, the details of viewpoint, scale and legend can be omitted.

4 "Let's Get Oriented", the following activity, complements this one, and will make a good follow-up or extension.

5 Many maps and books on maps are available through local libraries and sporting goods stores. If students show an interest, you can also explore map reading with a compass.

6 Plan a map day, when everyone can share a map from home. People have amazing secret supplies of maps left from previous explorations and vacations. These will give useful comparisons of viewpoint, scale, design, and legends. Students could vote which they find the most useful, beautiful, etc. Mapmakers of the past were highly skilled artists and technicians.

7 Plan a field trip to see how people actually use maps in their work. There are a number of fascinating options for this in the Grand Valley area.

8 Modern maps are increasingly being made with computers. A local engineering or surveying company, land development company, architectural firm or environmental assessment company might be willing to share some of the design technology that they now use.

a. The Colorado Department of Transportation would have an interesting selection of maps that they use in road management and planning.

b. Many federal government offices, such as the Bureau of Land Management or United States Forest Service, now use the GPS (Global Positioning System) for mapping. Maps of the future will use these advances in satellite and computer technology.

c. The Colorado Division of Wildlife may also have interesting maps that they use to track and protect wildlife.

Let's Get Oriented

ACTIVITY **PAGE**

Age Level

5th grade and up.

Purpose of the Activity

This activity is designed to introduce students to the way that maps are structured, and to help them begin to locate places on one. Using a scavenger hunt format, students attempt to locate items on the attached worksheet within a given amount of time.

Amount of Time Required

One class period or approximately 45 minutes.

Best Location

As maps must be spread out, a classroom, or site sheltered from the wind is recommended.

Materials Needed

- ☐ Map of Colorado — one for every two students.
- ☐ Map of Colorado National Monument — one for every two students.
- ☐ Topographic Map (optional).
- ☐ "Let's Get Oriented in Colorado" worksheets #1 and #2 — one for every student.
- ☐ Pencils — one for every student.

Background Information

Maps get us to new places. They help us find our way. They also offer a record of an amazing world beyond our familiar neighborhoods. Mount Everest, The Bay of Fundy, Corsica, Yemen, Baffin Island, Mongolia, Sri Lanka, Nigeria, Uzbekistan, the Amazon River, Antarctica, the Pyrenees…exotic and far away places come alive through maps.

Every map has a structure and features that make it unique. Learning how to read and use maps can be challenging. This activity uses a scavenger hunt format to make it fun. Students investigate a Colorado map and a Colorado National Monument map trying to locate important sites on both. They must first find information about the map itself, when it was made, and what the symbols mean. Then, they must identify specific places, roads, rivers, and landforms. The teacher may use the worksheet as a starting point or develop his or her own.

"Let's Get Oriented" works well as a supplement or addition to the "Mapmaker, Mapmaker, Make Me a Map" activity.

Let's Get Oriented

ACTIVITY PAGE

How to Do the Activity

Preparation for the activity involves locating enough Colorado maps for your class. Figure that you need one for every two students. Many families have them at home, and could lend them to the class for a day. Often the Chamber of Commerce has them available for purchase for a nominal fee, or for free. A local business or filling station might be willing to donate maps to your class. If this route is used, be sure to have students write or draw a map as a thank you note.

If you borrow the maps, make sure names are on them so they don't get lost or mixed up with others. If you are to have some permanently, consider laminating them to protect them for future use.

Colorado National Monument Official Map and Guides are available at no cost from the Visitor Center. One map is included in the back of this book. The Colorado Welcome Center just off Interstate 70 in Fruita is another source for them. Be sure to call ahead to let them know that you will be coming with a request for a large number of maps. Again, you will need one for every two students.

Topographic maps are available from local sporting goods and outdoor equipment stores. Again, you might be able to get them donated. You can also order them from the U. S. Geological Survey in Denver, Colorado 80225 or Reston, Virginia 22092. You can also check the U.S.G.S. website for further map options. A topographic map of Colorado National Monument specifically is sold at the CNM Visitor Center. It is more detailed and informative than the standard topographic map, and makes an excellent resource for the class.

Copy the worksheets, making any changes that you want.

Look at your maps and become familiar with the symbols and places shown on them. This will help you to direct the students without having to search around with them.

Let's Get Oriented

ACTIVITY PAGE

Step-by-Step Instructions

1 Chose a sheltered site if outdoors or move the desks out of the way and let the children lie on the floor of the classroom for this activity. Divide the class into teams of two. Each team will need a Colorado map. Let students look at the maps for a short while before passing out the scavenger hunt worksheets. Walk around the room to assist any team having difficulty. Setting a time limit for completion is optional.

2 When the Colorado map hunts are complete, give students the Colorado National Monument maps for comparison. What differences do they notice right away? Why are the maps so distinct? (The teacher may want to refer to the title of the Colorado National Monument map. It is both a map and a "guide." This is in keeping with the role of the monument, as part of the National Park Service, to educate people about what they are seeing. Parks are established to preserve and protect unique scenic, cultural, historic, and natural areas, and leave them "unimpaired for the enjoyment of future generations.") How does this compare to a road map, which is intended to help you find the road you need to get places? Which type of map does the class prefer? Is there a place for both?

If you have time, use the Colorado National Monument map worksheet. Students should complete it using the same process as with the Colorado map.

To continue your investigation of maps, share the topographic maps of the monument and worksheets next. Depending on the skill and interest level of the students, you may let them answer the questions on their own, or you may choose to do the worksheet together. Highlighting the different contour lines and other symbols on the chalkboard may be useful.

Conclusion

In Conclusion, take students on a "dream tour". This can be done in writing or verbally. Each child is an explorer preparing for a trip to a far away land. What country or place in the world would they go if they could go anywhere they want with no restrictions, and no parents? What things would they take with them that are ABSOLUTELY essential? Money, clothes, food, water, medicines, first aid, pack or luggage, tickets, toys are some of the things they might mention. Hopefully, now, too, they will remember a map!

Ways to Adapt This Activity for Other Ages

This activity is difficult to adapt for younger students as it is complex, detailed, and requires a facility with reading and vocabulary. However, children are never too young to look at globes, maps, atlases, or compasses to gain an appreciation for the world.

Let's Get Oriented

ACTIVITY PAGE

Extensions

- With a globe and an atlas, do a tour of the world. Spin the globe, close your eyes, and set your finger down at a random spot. Where did you land? Look up that place in the atlas for more close-up inspection. What is the capital of that place? Where are the mountains, rivers, deserts, ports, and highways — if any? Where is it in relation to the equator? How hot or cold do you think it would be there? An endless number of questions and curiosities are explored this way. For follow up, look your place up in the encyclopedia, or check out a book about it from your local library.
- See "Mapmaker, Mapmaker, Make Me A Map" in this manual.
- Teach students how to use a compass to assist in map reading.
- Practice the art of triangulation.
- Take the topographic map of Colorado National Monument to a trail and overlook, such as Otto's Trail or the Coke Ovens Trail and Overlook. Challenge students to find their location on the map. Afterwards, get them to identify mesas, buttes, monoliths, drainages, trails, roads, canyons, and even elevations on their maps.
- Hike Monument Canyon or No Thoroughfare Canyon using a topographic map to stay oriented.

Resources

Be Your Own Map Expert. Barbara Taylor. Sterling Publishing Company. New York, New York. 1994.

Earthsearch: A Kid's Geography Museum in a Book. John Cassidy. Klutz Press. Palo Alto, CA. 1994.

Everything You Need to Know About Geography Homework: A Desk Reference for Students and Parents. Anne Zeman and Kate Kelly. Irving Place Press. Scholastic Books. New York, New York. 1997.

Finding Your Way On Land And Sea: Reading Nature's Maps. Harold Gatty. Stephen Green Press. Brattleboro, VT. 1983.

How To Teach With Topographic Maps. Dana Van Burgh, Elizabeth Lyons, and Marcy Boyington. National Science and Teachers Association. Arlington, VA. 1994.

United States Geological Survey. Denver, Colorado 80225 or Reston, Virginia 22092. Look also for their website.

Let's Get Oriented in Colorado
Worksheet #1

ACTIVITIES FOR STUDENTS

Directions

With your Colorado map spread out in front of you, look it over from top to bottom. Then, get more specific, and see if you can find the following 25 items. Some are cities and towns; others are rivers and significant lands or parks. You will also need to locate features of the map itself, such as the title of the map, date of publication, explanation of symbols, etc. Fill in the blanks or put a check mark on your sheet when you find an answer. If you cannot locate an item, move on, and return after you have the other answers completed. GOOD LUCK!

Find the following items on your Colorado map:

1. What is the title of your map? _____

2. Who produced or published it? _____ Year? _____

3. Does your map have legend or explanation of symbols? ☐ yes ☐ no

4. What is the scale of your map? _____

5. Can you find a grid system of numbers or letters or both to help locate places on the map?
☐ yes ☐ no

Locate these places:

☐ Grand Junction
☐ Montrose
☐ Colorado Springs
☐ Pueblo
☐ Bent's Old Fort
☐ Black Canyon of the Gunnison National Park
☐ Colorado National Monument
☐ Dinosaur National Monument
☐ Rocky Mountain National Park
☐ Mesa Verde National Park
☐ Pawnee National Grasslands
☐ Colorado River
☐ Gunnison River
☐ Fruita
☐ Denver
☐ Boulder
☐ Sterling
☐ Cortez
☐ Arkansas River
☐ South Platte River

Optional:

☐ Find a national forest
☐ Southern Ute Indian Reservation
☐ Find a county line
☐ Ute Mountain Indian Reservation

Let's Get Oriented in Colorado
Worksheet #2

ACTIVITIES FOR STUDENTS

Directions

Spread out the Colorado National Monument (CNM) Official Map and Guide. Look on both sides. Then, answer the following questions about your observations of the map.

1. Name three differences that you notice between this map and the Colorado map.

   _____

   _____

2. Locate the scale of the CNM map. Compare it with the Colorado map.
   One inch at CNM equals how many miles? _____
   One inch on the Colorado map equals how many miles? _____
   Which map shows more detail? _____

   If the Colorado map and the CNM map had the same scale, what would happen?
   (Hint: Imagine what the CNM map would look like if the scale were 20 miles equals one inch. Would it be bigger or smaller? If you are not sure, look at the Colorado map and see how tiny CNM is.)

   _____

   _____

3. Find the legend or explanation of symbols on the CNM Offical Map and Guide.
   What does – – – – – mean? _____
   What does —•— mean? _____

4. Find the East (Grand Junction) Entrance to the monument.
   Find the West (Fruita) Entrance to the monument.

5. Locate Rim Rock Drive. How many whole tunnels are there on it? _____

6. How many canyons, large and small, are in the monument? _____

7. What is the elevation of the highest point on Rim Rock Drive? _____

8. What community has two roads coming into Rim Rock Drive? _____

9. What is the name of the campground in Colorado National Monument? _____

10. The Visitor Center is closer to which entrance of the monument? ☐ East ☐ West

11. How many picnic areas are there in the monument? _____

12. How high is Independence Monument? _____

13. Who said these canyons "felt like the heart of the world to me"? _____

14. In what year was the monument created? _____

15. How many square miles are in the monument? _____

Answer Sheet for Let's Get Oriented in Colorado Worksheet #2

1. Three differences are: size, shape, scale. Other possible answers are:
   - The amount of information given for CNM is greater than for places on the Colorado map.
   - Colorado National Monument is only a small part of the state.

2. One inch on the CNM map equals one mile; on the Colorado map one inch is 20 miles.

3. – – – – – means trail. —•— means overlook.

5. There are three whole tunnels and one "half" tunnel.

6. There are eleven canyons.

7. The highest point is just past Ute Canyon View at 6640 ft. or 2024 m.

8. Glade Park.

9. The campground is called Saddlehorn.

10. The Visitor Center is closer to the West (Fruita) Entrance.

11. There are two official picnic areas: Devils Kitchen and Saddlehorn.

12. Independence Monument is 450 feet high.

13. John Otto said those words. He was instrumental in founding the monument.

14. Colorado National Monument was founded in 1911.

15. Colorado National Monument is 32 square miles in size.

Geologic Pursuits

ACTIVITY PAGE

Age Level

4th through 8th grades.

Purpose of the Activity

The purpose of this activity is to give students an opportunity to test what they know about geology in general, and Colorado National Monument in particular. The format, similar to a game of musical chairs, is sure to keep pupils on their toes!

Amount of Time Required

Fifteen to twenty minutes of preparation.

The game itself moves quickly. How long it lasts is determined by how many questions there are to answer. Twenty-five questions last approximately fifteen minutes.

Materials Needed

- ☐ Paper plates: one for each student.
- ☐ Wide-tipped marker.
- ☐ A list of questions about geology (or any other subject) to which only the teacher has the answers. The questions provided with this activity are just a starting point; many more questions can be added.
- ☐ *(Optional)* Rocks to hold down paper plates in the wind may be needed if the game is played outside on a windy day. One fist-sized rock per plate should work.

Best Location

Location is flexible. It can be indoors or outdoors, but a space for students to run is needed. Options include a gymnasium, playing field, parking lot, even a classroom where the chairs have been pushed back. Noise can be a factor in determining the location of this game, as students tend to yell out the answers.

Geologic Pursuits

ACTIVITY PAGE

Background Information

"Geologic Pursuits" is a fun game to use as a filler at the end of a class; to wake students up on a sleepy morning; to introduce a new topic, or to review an old one; even to use while waiting for a bus at the end of a field trip. Students will enjoy the combination of moving and thinking while in "pursuit." Teachers will appreciate getting an idea how much pupils have retained out of a lecture or study session, while chuckling over the "hunt" for answers.

At the heart of this activity is a list of twenty-five true or false questions about geology. The questions are based on general geology as well as topics specific to Colorado National Monument. They are meant to act as a resource for the teacher, who may choose to develop a question list that is specific to both his or her curriculum and the needs and interests of the students. Teachers should feel free to make up questions on other subjects as well. "Geological Pursuits" is a very adaptable game.

This activity does not stress competition so much as it encourages individual achievement. After the teacher asks a question about geology, students must show their answer by running to a plate that is marked with "T" for "True", or "F" for "False". Those who do not have the right answer are not penalized, nor are those who are accurate rewarded. It is merely a game of wits — with plenty of running around! In the Extensions section of this activity, however, other ways to play "Geologic Pursuits" more competitively are suggested.

Geologic Pursuits

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How to Do the Activity

Step-by-Step Instructions

Preparations

1 Review the questions about geology that follow. Use them, or others that reflect topics from your curriculum, to create a list of twenty-five (or more) questions to ask the students. All answers must be "true" or "false". The resulting questions will be the centerpiece of the game of "Geologic Pursuits". You may want to develop a few easy questions to use at the start, while the students get familiar with how the game works. Several bonus questions to challenge what they know might be fun for the end of the game.

2 Gather one paper plate per student, plus a few extras. On half of the plates, mark a large, bright-colored "T" for True. Make an "F" for false on the other half. Keep two or three blank. Students will answer the questions by running to either a "T for True" plate or an "F for False" plate.

3 Make sure that you have a large enough space to accommodate the game. An area at least forty to fifty feet long and twenty-five feet wide, should be used. This allows the class to spread out and really run to the answer plates. As movement is key to the enjoyment of the game, a larger space is preferred, but running distances can be consolidated to accommodate smaller spaces. Also, keep in mind that "Geologic Pursuits" can become very noisy, which also affects the choice of site. If possible, avoid asphalt and cement surfaces. They can be hazardous to the skin on knees of the runners. If no other alternative is available but asphalt, allow only walking to get to the answers.

4 Preparing the game field ahead of time is helpful, but not necessary. Students can easily be incorporated into the process, by setting out plates, and pacing off distances.

a) Choose a starting line for the game. Mark it at either end with a *blank* paper plate. It should be in the middle of the space to be used. Optimally, twenty to twenty-five feet of open space should be available on either side of this line. Plan for students to be single file along this line. This is the place where everyone must be when the questions are read.

b) From the starting line, pace off twenty-five feet in one direction. Make a line of "T for true" plates that parallels the starting line. Leave some space between each plate.

c) Return to the starting line. Pace off twenty-five feet in the opposite direction for a row of "F for false" plates. The result should be three parallel lines, two of which have 10 to 15 plates, and one of which marks the center starting line.

A Reminder: The plates should be placed in a line on the ground with all the "T's" or all the "F's" facing skywards. Plates should not touch. This gives students space to stand on the plates with their feet. Remember, in total, there should be one plate per student. Half of those should be marked with "T", and the other half with "F".

Geologic Pursuits

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The Game of "Geologic Pursuits"

1 Begin by explaining what the class will be doing: testing their knowledge of geology (or other subjects) by answering a series of true-or-false questions. To do this, students will listen to a question read by the teacher, and then state their answer by running to either a "true" plate, marked with the letter "T", or a "false" plate, marked with the letter "F".

2 Ask students to form a single-file line between the two blank plates in the middle of the game field. This becomes the starting line for the rest of the game. Ask students to look in one direction, to the plates marked "T" for "True." If they think the answer to a question is "true", then they should run as fast as they can to the "T" for "True" plates. Ask students to look in the other direction to the "F" for "false" plates. If they think the answer to a question is false, then that is the direction that they should run.

3 Try a practice question. Ask the students to point to the correct answer: "The sky is blue."

4 Now, go over the rules of the game.

RULES for "Geologic Pursuits"

1. This is a test of how much you have learned about geology.
2. When you think you know the answer to a question, run to the plate marked T (for true) or F (for false). Stand on it.
3. *Only two people are allowed to stand on any plate.* If there are more than two, and a dispute occurs, then everyone must get off and return to the starting line.
4. If you cannot get on a plate, go back to the starting line, and see if you can answer the next question more quickly.
5. Stay on your answer plate until the correct answer is given. Then return to the starting line for the next question.
6. No pushing or shoving is permitted. You are automatically out if this occurs.
7. The teacher is the final arbitrator, and whatever he or she says is not to be disputed.

5 The teacher should stand at the head of the starting line facing the students, and read questions and give answers from there. Remind them that those who do not find a plate return to the middle. Those who answered incorrectly are next to return to the middle line. Finally, everyone who correctly answered returns to the middle in preparation for the next question. Stress safety and respect for one another.

6 Play the game until all the questions have been answered. Afterwards, the class may want to discuss any questions that were difficult to answer, or ones to which they thought there would be more than one answer.

Geologic Pursuits

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Conclusion

"Geologic Pursuits" is an active and fun way for the teacher and students to find out how much they know about a subject such as geology. With a few props and a little preparation, this activity may be used as a filler between other topics or projects, or it may be extended to cover an entire class period.

Ways to Adapt the Activity for Other Ages

This game can be played with any subject, from math to oceanography to spelling. It can also be used by a variety of age groups, with the subject matter appropriate to their classroom studies. Everyone enjoys the movement, and the similarity to the familiar parlor game of musical chairs. What is unique about "Geologic Pursuits" is it does not stress competition, but places the focus on each individual's achievement.

Extensions

A) A fun variation of "Geologic Pursuits" is to conduct it like the long-time favorite parlor game, "Musical Chairs". To do this, arrange students as before, on the starting line. The "T for True" and "F for False" plates should be in the same lines. The rules of "Geologic Pursuits" remain the same, with several changes.

First, while the game begins with enough plates for everyone to land on an answer, *with each question, one "T for True" plate and one "F for False" plate are removed*. As a result, students must choose an answer to a question as quickly as possible to assure that they reach a spot on a plate. If a student cannot find a vacant spot on a plate, he or she is out of the game, and must step to the sidelines.

Second, those with the wrong answer are also out of the game.

Third, the last two people remaining in the game have a run-off. Whoever reaches the plate with the correct answer first is the winner.

B) For older students, the accuracy of their answers can be tracked. Enlist one or two students to make a list of students in the class. As each question is answered, the "trackers" record those who answered incorrectly, or did not find an empty plate. Later, the class can make a bar graph, or other type of graph, to show how many answers each student knew.

Geologic Pursuits

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Geologic Pursuits Question Sheet

Questions	Answers
1. Geology is the study of the solar system.	False
2. The Earth is made up of the atmosphere, the crust, the mantle, and the core.	True
3. As soon as a rock is exposed to the air it begins to grow.	False
4. Someone who makes maps of the Earth is known as a paleontologist.	False
5. Lava is a type of igneous rock.	True
6. Dinosaur bones are found in the Morrison Formation.	True
7. The outermost layer of the Earth is the mantle.	False
8. Mica is a shiny mineral that creates sparkles in some rocks.	True
9. Mudstones, siltstones, and sandstones are types of sedimentary rock.	True
10. Topographic maps are useful to help you get around in urban areas.	False
11. Stratigraphy is the study of rock layers.	True
12. The Laramide Orogeny took place in Laramie, Wyoming on 9/11/1875.	False
13. Colorado National Monument became part of the National Park Service in order to protect the large number of dinosaur bones discovered there.	False
14. Quartz is a mineral composed of tiny grains of salt.	False
15. Chinle, Wingate, and Kayenta are three rock formations found locally.	True
16. Metamorphic rocks contain many interesting fossils.	False
17. Freezing and thawing, tree roots, heating and cooling all contribute to the breakdown of rocks into smaller and smaller pieces.	True
18. A map legend is a story told by geologists about where to find gold.	False
19. Precambrian rock is the oldest rock known at Colorado National Monument.	True
20. Desert varnish is a white powdery crust occurring on some rocks.	False
21. Anticlines look like arches and synclines look like troughs.	True
22. The core of the Earth is estimated to be between 200 and 300 degrees F.	False
23. Uniformitarianism is a premise that things happening today on the Earth are different from things that happened in the past.	False
24. Igneous rock is formed by layers of rock building up on one another.	False
25. When you look down into a canyon, the oldest rocks are at the bottom.	True

Three Types of Rocks:
The True Origins of Rock and Roll

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 4** Listening 4.01 4.05 4.06 4.08 Thinking 4.01 4.03 4.07 4.08 4.15 **Standard 5** Thinking 4.04 4.06 4.18	**Standard 4** Listening 5.02 5.03 5.05 5.06 5.08 Thinking 3-5.01 3-5.04 3-5.15 3-5.17	**Standard 4** 6.25 6.26	**Standard 4** 7.24 7.26 7.28	**Standard 4** 8.23 8.20
Math	**Standard 2** 4.2.1 4.2.3 **Standard 3** 4.3.1 4.3.2	**Standard 2** 5.2.1 5.2.2 5.2.3 **Standard 3** 5.3.1 5.3.3 5.3.4 5.3.5 5.3.6	**Standard 2** 2.1 2.3 **Standard** 3.3 3.4 3.5 3.6	**Standard 2** 2.1 2.3 **Standard 3** 3.3 3.4 3.5 3.6	**Standard 2** 2.1 2.3 **Standard 3** 3.3 3.4 3.5 3.6
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** 2.11 2.12 2.21 **Standard 4** 4.14 **Standard 6** 6.01 6.02 6.03 **Standard 7** 7.03	**Standard 1** 1.03 1.05 1.06 1.08 **Standard 2** 2.11 2.33 **Standard 6** 6.01 6.02 **Standard 7** 7.03 7.04	**Standard 1** 6.1.01 6.1.03 6.1.05 6.1.06 6.1.07 6.1.08 **Standard 2** 6.2.01 6.2.02 **Standard 4** 6.4.01 6.4.02 **Standard 7** 6.7.03 6.7.04	**Standard 1** 7.1.01 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 **Standard 2** 7.2.01 7.2.04 7.2.05 **Standard 7** 7.7.03 7.7.04	**Standard 1** 8.1.01 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 **Standard 2** 8.2.01 8.2.05 8.2.06 **Standard 7** 8.7.03 8.7.04

Make a Stratigraphic Column
of Colorado National Monument

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 4** Reading Obj. 4.09 Listening Obj. 4.01 4.02 4.05 4.08 Thinking Obj. 4.01 4.03 4.07 4.08 4.21 **Standard 5** 4.06	**Standard 4** 5.02 5.05 5.08 5.06 **Standard 5** 5.23	**Standard 4** 6.3.04 6.2.05	**Standard 4** 7.2.04 7.2.06	**Standard 4** 8.17 8.23 8.35
Math	**Standard 2** 4.2.1 4.2.3 **Standard 3** 4.3.1 **Standard 4** 4.4.1a 4.4.2 4.4.3 4.4.5	**Standard 2** 5.2.1 5.2.3 **Standard 3** 5.3.1 5.3.5 **Standard 4** 5.4.1 5.4.2 **Standard 5** 5.5.2 5.5.3	**Standard 2** 6.2.1 6.2.3 **Standard 3** 6.3.1 6.3.5 **Standard 4** 6.4.1 6.4.2 **Standard 5** 6.5.2 6.5.3	**Standard 2** 7.2.1 7.2.3 **Standard 3** 7.3.1 7.3.5 **Standard 4** 7.4.1 **Standard 5** 7.5.2 7.5.3	**Standard 2** 8.2.3 **Standard 3** 8.3.1 8.3.5 **Standard 4** 8.4.1 8.4.2 **Standard 5** 8.5.2 8.5.3
Science	**Standard 1** 1.04 **Standard 2** 2.1 2.11 2.12 2.3 2.31 **Standard 3** 3.2 3.22 3.23 3.4 3.44 **Standard 4** 4.1 4.12 4.14 **Standard 7** 7.01 7.02 7.04 7.05	**Standard 1** 1.02 1.05 1.06 1.07 1.08 **Standard 2** 2.1 2.11 **Standard 4** 4.25 **Standard 7** 7.01 7.02 7.03 7.04 7.05	**Standard 1** 6.1.01 6.1.02 6.1.05 6.1.06 6.1.07 6.1.08 6.1.10 **Standard 2** 6.2.01 6.2.02 **Standard 4** 6.4.01 6.4.02 **Standard 7** 6.7.01 6.7.02 6.7.03 6.7.04 6.7.05	**Standard 1** 7.1.01 7.1.02 7.1.05 7.1.06 7.1.07 7.1.08 7.1.10 **Standard 2** 7.2.01 7.2.03 7.2.05 **Standard 4** 7.4.01 **Standard 7** 7.7.01 7.7.02 7.7.03 7.7.04 7.7.05	**Standard 1** 8.1.01 8.1.02 8.1.05 8.1.06 8.1.07 8.1.08 8.1.10 **Standard 2** 8.2.01 8.2.05 8.2.06 **Standard 3** 8.3.09 **Standard 4** 8.4.01 8.4.02 **Standard 7** 8.7.01 8.7.02 8.7.03 8.7.04 8.7.05

Make a Stratigraphic Column
of Colorado National Monument

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Social Studies	**Geography** **Standard 1** 4.40 **Standard 2** 4.45 4.50 4.51	**Geography** **Standard 4** 5.18 5.38	**Geography** **Standard 1** 6.19 **Standard 4** 6.35 6.36	**Geography** **Standard 1** 7.23 7.24 7.27 7.28 **Standard 2** 7.35 **Standard 4** 7.59 7.60 7.62 7.63	**Geography** **Standard 1** 8.11 8.12 8.15 **Standard 2** 8.18 8.19 **Standard 4** 8.40 8.41
Art	**Standard 1** **Standard 2**	**Standard 1** **Standard 2**	**Standard 1** Art .01 Art .02 **Standard 2** Art .04 Art .09 Art .11	**Standard 1** Art .01 Art .02 **Standard 2** Art .04 Art .09 Art .11	**Standard 1** Art .01 Art .02 **Standard 2** Art .04 Art .09 Art .11

Stratigraphy Up and Down Hike

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Writing Obj. 4.01 4.05 4.08 4.12 4.07 Thinking Obj. 4.02 4.06 4.07 **Standard 3** Reading Obj. 4.03 4.04 4.05 4.06 4.09 4.10 4.11 4.21 **Standard 4** Writing Obj. 4.09 4.10 4.11 Listening Obj. 4.01 4.02 4.05 4.08 Thinking Obj. 4.01 4.03 4.15 4.16 4.21 4.07 4.08	**Standard 1** Writing Obj. 5.01 5.05 5.07 **Standard 3** 5.05 5.06 5.12 **Standard 4** Listening Obj. 5.02 5.05 5.08 5.10 Thinking Obj. 3-5.01 3-5.04 3-5.05 **Standard 5** 5.23	**Standard 4** 6.01 6.06 6.20 6.22 6.25 6.27 6.34	**Standard 4** 7.01 7.08 7.19 7.22 7.24 7.26 7.27 7.28 7.35	**Standard 4** 8.01 8.02 8.14 8.17 8.23
Math	**Standard 1** 4.1.3 **Standard 2** 4.2.1 4.2.2 4.23 **Standard 3** 4.3.1 4.3.2 4.4.5	**Standard 2** 5.2.1 5.2.3 **Standard 3** 5..3.1 5.3.4 5.3.5 5.3.6 5.3.7 **Standard 5** 5.2	**Standard 2** 2.1 2.3 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.3	**Standard 2** 2.1 2.3 **Standard 3** 3.1 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.3	**Standard 3** 3.1 3.3 3.4 3.5 3.6 3.7 **Standard 5** 5.2 5.3

Stratigraphy Up and Down Hike

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** 2.1 2.11 2.12 **Standard 4** 4.1 4.12 4.14 4.15 **Standard 5** 5.01 5.05 **Standard 6** 6.03 **Standard 7** 7.02 7.03 7.04 7.05	**Standard 1** 1.02 1.03 1.05 1.06 1.07 1.08 **Standard 2** 2.1 2.11 **Standard 3** 3.24 3.43 **Standard 6** 6.02 **Standard 7** 7.02 7.03 7.05 7.06	**Standard 1** 6.1.02 6.1.03 6.1.04 6.1.05 6.1.06 6.1.07 6.1.08 **Standard 2** 2.1 6.2.01 6.2.02 2.3 6.2.04 **Standard 3** 3.2 6.3.01 6.3.02 **Standard 4** 4.1 6.4.01 6.4.02 **Standard 6** 6.6.01 **Standard 7** 6.7.03 6.7.05 6.7.06	**Standard 1** 7.1.02 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 **Standard 2** 2.1 7.2.01 7.2.02 7.2.03 7.2.05 **Standard 4** 4.2 7.4.02 **Standard 6** 7.6.02 **Standard 7** 7.7.02 7.7.03 7.7.05 7.7.06	**Standard 1** 8.1.02 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 **Standard 2** 2.1 8.2.01 8.2.02 2.3 8.2.05 8.2.06 **Standard 3** 3.4 8.3.09 8.3.10 **Standard 4** 4.1 8.4.01 8.4.02 4.2 8.4.03 **Standard 7** 8.7.02 8.7.03 8.7.05 8.7.06
Social Studies	**Geography** **Standard 1** **Standard 2** 4.45 4.49	**Geography** **Standard 1** 5.18 **Standard 4** 5.18 5.38	**Geography** **Standard 2** 6.21 6.22 6.23 6.24 **Standard 4** 6.35 6.36 6.37 6.38 6.39	**Geography** **Standard 1** 7.24 7.25 7.26 7.28 **Standard 2** 7.35 7.36 7.37 7.38 **Standard 4** 7.59 7.60 7.62 7.63	**Geography** **Standard 1** 8.11 8.12 8.13 8.14 8.15 **Standard 2** 8.18 8.19 **Standard 4** 8.40 8.43
Art	**Standard 1**	**Standard 1**	**Standard 1** Art .01 **Standard 2** Art .04 Art .09 Art .11 **Standard 3** Art .12 Art .14	**Standard 1** Art .01 **Standard 2** Art .04 Art .09 Art .11 **Standard 3** Art .12 Art .14 Art .17	**Standard 1** Art .01 **Standard 2** Art .04 Art .09 Art .11 **Standard 3** Art .12 Art .14 Art .17

Erosion Hike

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Writing Obj. 4.05 4.07 4.08 4.12 Thinking Obj. 4.06 4.07 **Standard 3** 4.21 **Standard 4** Listening Obj. 4.01 4.02 4.05 4.08 Thinking Obj. Obj. 4.01 4.03 4.14 4.15 4.20	**Standard 1** Writing Obj. 5.07 **Standard 3** 5.05 5.06 **Standard 4** 5.11 Listening Obj. 5.02 5.05 5.08 Thinking Obj. 3-5.01 3-5.04 3-5.15 **Standard 5** 5.01 5.23	**Standard 1** 6.32 6.37 **Standard 2** 6.18 **Standard 4** 6.01 6.06 6.20 6.22 6.25 6.27 6.34 6.37	**Standard 4** 7.01 7.08 7.19 7.21 7.22 7.24 7.26	**Standard 4** 8.01 8.02 8.14 8.17 8.20 8.23 **Standard 5** 8.33
Math	**Standard 1** 4.13 **Standard 2** 4.2.1 4.2.3 **Standard 3** 4.3.1 4.3.2 **Standard 4** 4.4.5 **Standard 5** 4.5.2 4.5.3a 4.5.3.b	**Standard 2** 5.2.1 5.2.3 **Standard 3** 5.3.1 5.3.3 5.3.4 5.3.5 5.3.6 5.3.7 **Standard 5** 5.5.1 5.5.2 5.5.3	**Standard 2** 6.2.1 6.2.2 **Standard 3** 6.3.1 6.3.3 6.3.4 6.3.5 6.3.6 6.3.7 **Standard 5** 6.5.1 6.5.2 6.5.3	**Standard 2** 7.2.1 **Standard 3** 7.3.1 7.3.3 7.3.4 7.3.5 7.3.6 7.3.7 **Standard 5** 7.5.2 **Standard 6** 7.6.3	**Standard 2** 8.2.1 **Standard 3** 8.3.1 8.3.3 8.3.4 8.3.5 8.3.6 8.3.7 **Standard 5** 8.5.2 **Standard 6** 8.6.3
Science	**Standard 1** 1.01 1.02 1.03 1.04 **Standard 2** 2.11 2.12 **Standard 3** 3.14	**Standard 1** 1.02 1.03 1.05 1.06 1.07 1.08 **Standard 2** 2.11 2.33	**Standard 1** 6.1.02 6.1.03 6.1.05 6.1.06 6.1.07 6.1.08 **Standard 2** 6.2.01 6.2.04	**Standard 1** 7.1.02 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 **Standard 2** 7.2.01 7.2.02	**Standard 1** 8.1.02 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 **Standard 2** 8.2.01 8.2.02

Erosion Hike

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science (cont.)	**Standard 4** 4.12 4.14 4.15 4.22 4.31 **Standard 7** 7.01 7.02 7.04	**Standard 4** 4.25 **Standard 7** 7.01 7.02 7.03 7.05	**Standard 3** 6.3.01 6.3.02 **Standard 4** 6.4.01 6.4.02 6.4.07 **Standard 7** 6.7.01 6.7.02 6.7.03 6.7.05	**Standard 2** (cont.) 7.2.05 **Standard 4** 7.4.01 **Standard 7** 7.7.01 7.7.02 7.703 7.7.05	**Standard 2** (cont.) 8.2.03 8.2.05 8.2.06 8.2.07 8.2.08 **Standard 4** 8.4.01 8.4.02 8.4.03 **Standard 7** 8.7.01 8.7.02 8.7.03 8.7.05
Social Studies	**Geography** **Standard 2** 4.45 **Standard 4** 4.63 4.64 4.65 4.67	**Geography** **Standard 1** 5.18 **Standard 3** 5.05 **Standard 4** 5.18 5.38	**Geography** **Standard 4** 6.35 6.36 6.38	**Geography** **Standard 1** 7.33 **Standard 2** 7.35 7.36 **Standard 4** 7.59 7.60 7.62 7.63 7.66	**Geography** **Standard 1** 8.16 **Standard 2** 8.18 8.19 **Standard 4** 8.40 8.41 8.43

Mapmaker, Mapmaker, Make Me a Map

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 1** Reference Obj. 4.26 Thinking Obj. 4.06 4.07 **Standard 3** 4.01 4.04 4.05 4.06 4.21 **Standard 4** Listening Obj. 4.01 4.02 4.05 4.08 Thinking Obj. 4.01 4.08 4.16 4.21 **Standard 5** 4.11	**Standard 3** 5.05 5.06 **Standard 4** Listening Obj. 5.02 5.08 Thinking Obj. 3-5.01 3-5.04 **Standard 5** Reading Obj. 5.01 5.23 5.06 5.07 Reference Obj. 5.23	**Standard 4** 6.01 6.06 6.20 6.25 6.34	**Standard 1** 7.43 **Standard 4** 7.01 7.08 7.19 7.22 7.24	**Standard 4** 8.01 8.02 8.14 8.23
Math	**Standard 1** 4.1.3 **Standard 4** 4.4.1a 4.4.2 4.4.5 **Standard 5** 4.5.1 4.5.2 4.5.3a 4.5.3b	**Standard 2** 5.2.1 5.2.3 **Standard 4** 5.4.1 5.4.2 **Standard 5** 5.5.1 5.5.2 5.5.3 5.5.6	**Standard 2** 6.2.1 6.2.3 **Standard 4** 6.4.1 6.4.2 **Standard 5** 6.5.1 6.5.2 6.5.3 6.5.6	**Standard 2** 7.2.1 7.2.3 **Standard 4** 7.4.1 7.4.2 **Standard 5** 7.5.1 7.5.2 7.5.3 7.5.6	**Standard 2** 8.2.3 **Standard 4** 8.4.1 8.4.2 8.4.4 **Standard 5** 8.5.1 8.5.2 8.5.3 8.5.6
Science	**Standard 1** 1.02 1.03 1.04 **Standard 2** 2.11 2.12 **Standard 6** 6.01 6.02 6.03 **Standard 7** 7.03 7.04	**Standard 1** 1.03 1.05 1.06 1.07 **Standard 2** 2.11 **Standard 7** 7.04 7.05	**Standard 1** 6.1.03 6.1.05 6.1.06 6.1.07 **Standard 2** 6.2.11 **Standard 7** 6.7.04 6.7.05	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 **Standard 2** 7.2.11 **Standard 7** 7.7.03 7.7.04	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 **Standard 2** 8.2.11 **Standard 7** 8.7.03 8.7.04

Mapmaker, Mapmaker, Make Me a Map

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Social Studies	**Geography** **Standard 1** 4.39 4.40 **Standard 2** 4.49 4.50 **Standard 4** 4.65 4.67	**Geography** **Standard 1** 5.18 **Standard 4** 5.18 5.38	**Geography** **Standard 1** 6.16 6.19 **Standard 2** 6.21 **Standard 4** 6.35 6.36 6.38	**Geography** **Standard 1** 7.23 7.24 7.25 7.26 7.27 7.28 7.30 **Standard 2** 7.35 7.36 **Standard 4** 7.59 7.60 7.62 7.63	**Geography** **Standard 1** 8.11 8.12 8.14 8.15 8.16 **Standard 2** 8.18 8.19 **Standard 4** 8.40 8.41 8.43
Art	**Standard 1**	**Standard 1**	**Standard 1** Art .01 **Standard 2** Art .04 Art .09 Art .10 Art .11 **Standard 3** Art .12 Art .13 Art .14 **Standard 4** Art .23	**Standard 1** Art .01 **Standard 2** Art .04 Art .09 Art .10 Art .11 **Standard 3** Art .12 Art .13 Art .14 **Standard 4** Art .23	**Standard 1** Art .01 **Standard 2** Art .04 Art .09 Art .10 Art .11 **Standard 3** Art .12 Art .13 Art .14 **Standard 4** Art .23

Let's Get Oriented

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts		**Standard 1** Reading Obj. 5.13 Thinking Obj. 3-5-18 **Standard 3** 5.05 5.06 5.09 5.11 5.12 **Standard 4** Reading Obj. 5.11 Listening Obj. 5.02 5.08 Thinking Obj. 3-5.01 3-5.04 3-5.17 **Standard 5** 5.06 5.23	**Standard 1** 6.20 6.22 6.25 **Standard 3** 6.01 6.05 **Standard 4** 6.06 6.20 6.22 6.25 6.34	**Standard 2** 7.19 7.23 **Standard 4** 7.01 7.08 7.22 7.24 7.26 7.38 **Standard 5** 7.39	**Standard 4** 8.01 8.02 8.14 8.17 8.20 8.23 8.35 **Standard 5** 8.33
Math		**Standard 2** 5.2.1 **Standard 3** 5.3.1 5.3.3 5.3.4 5.3.7 **Standard 5** 5.5.1 5.5.2 5.5.3 5.5.4	**Standard 2** 6.2.1 **Standard 3** 6.3.1 6.3.3 6.3.6 6.3.7 **Standard 5** 6.5.1 6.5.2 6.5.3 6.5.4	**Standard 2** 7.2.1 **Standard 3** 7.3.1 7.3.3 7.3.6 7.3.7 **Standard 5** 6.5.1 6.5.2 6.5.3 6.5.4	**Standard 2** 8.2.1 **Standard 3** 8.3.1 8.3.3 8.3.6 8.3.7 **Standard 5** 8.5.1 8.5.2 8.5.3 8.5.4
Science		**Standard 1** 1.03 1.05 1.06 1.07 1.08 1.12 **Standard 2** 2.11 **Standard 5** 5.04 **Standard 7** 7.05	**Standard 1** 6.1.03 6.10.5 6.1.06 6.1.07 6.1.08 6.1.12 **Standard 2** 6.2.11 **Standard 5** 6.5.03 **Standard 7** 6.7.05	**Standard 1** 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08 7.1.12 **Standard 2** 7.2.11 **Standard 5** 7.5.03 **Standard 7** 7.7.05	**Standard 1** 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08 8.1.12 **Standard 2** 8.2.11 **Standard 5** 8.5.03 **Standard 7** 8.7.05

Let's Get Oriented

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Social Studies			**Geography** **Standard 1** 6.16 6.19 **Standard 2** 6.21	**Geography** **Standard 1** 7.23 7.24 7.25 7.27 7.28 7.30 7.33 **Standard 2** 7.35 **Standard 4** 7.59 7.60 7.62	**Geography** **Standard 1** 8.11 8.12 8.15 8.16 **Standard 2** 8.18 8.19 **Standard 4** 8.40 8.41 8.43

Geologic Pursuits

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts	**Standard 4** Listening Obj. 4.01 4.02 4.05 4.08 Thinking Obj. 4.07 4.13 4.14 4.15	**Standard 4** Listening Obj. 5.02 5.06 5.08 5.09	**Standard 4** 6.25 6.35	**Standard 4** 7.22 7.24	**Standard 4** 8.23
Math					
Science	**Standard 2** 2.1 2.11 2.12 2.2 2.21 **Standard 4** 4.1 4.12 4.14	**Standard 1** 1.06 1.08 **Standard 2** 2.1 2.11	**Standard 1** 6.1.06 6.1.08 **Standard 2** 2.11 **Standard 4** 6.4.01 6.4.02	**Standard 1** 7.1.06 7.1.08 **Standard 2** 7.2.01	**Standard 1** 8.1.06 8.1.08 **Standard 2** 8.2.01 **Standard 3** 8.3.09 **Standard 4** 8.4.01 8.4.02

Depending on the questions that the teacher chooses, this activity can be adapted to meet many other content standards. "Geologic Pursuits" works well for subjects like a quiz on spelling or vocabulary, a review of historical figures or events, an investigation of food chains, or test of math facts.

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The written and verbal comments of Dr. Bill Hood, Professor of Geology at Mesa State College have been of immeasurable assistance in the development of this chapter. Dr. Hood was generous with his time and his vast knowledge, for which the author is grateful.

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CHAPTER FIVE

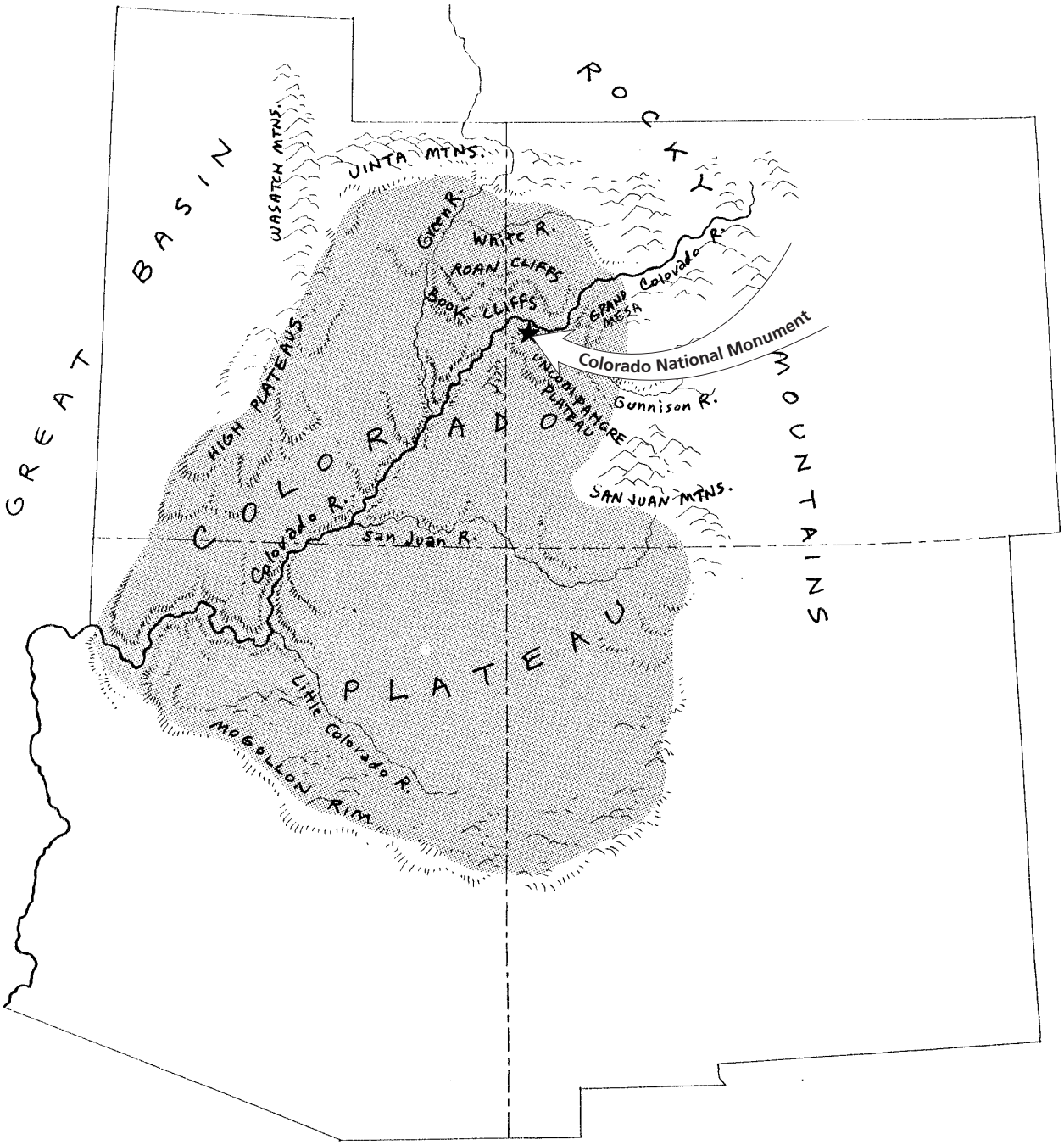
Beyond the Scenery

The National Park Service and Colorado's Other Land Management Agencies

Photo from *Through the Eyes of the Children*
by Diane Hirschinger Gallegos and Tope Elementary Students

Colorado Plateau

Colorado National Monument is part of the geologic province called the Colorado Plateau.



Who Manages Our Public Lands?

BACKGROUND FOR **TEACHERS**

Colorado has an abundance of scenic places within its borders. Alpine meadows and deep canyons stand out against rolling grasslands and plains. Sagebrush deserts are balanced out by miles of rivers, streams, lakes, and reservoirs. Bustling cities and towns contrast with wilderness areas, forests, parks, and wildlife refuges. Unique geology and paleontology are plentiful. Historic mining and cultural sites are widespread. Behind this scenery are numerous private and public organizations that seek to care for and protect the diverse resources within the state. They also make it possible for the public to enjoy these places safely and comfortably.

The Nature Conservancy, the Trust for Public Land, and the Colorado Coalition of Land Trusts are some of the private groups successfully managing thousands of acres of land in Colorado. Through donations of ranch land, river bottoms, grasslands, forests, wetlands, and other types of open space, they seek to preserve habitat that plants, animals, and natural communities need in order to survive, and to sustain the diversity of life on Earth. With tools such as cooperative agreements and conservation easements, these groups actively work with individual landowners who seek to protect unique or important tracts of land on behalf of wildlife or plantlife.

Within the public sector, the number of organizations seems to burgeon forth. Most cities and towns host parks and recreation departments that operate city parks, recreation facilities, and trail systems. The State of Colorado oversees state parks, school trust lands, and wildlife areas. Nationally, the Bureau of Land Management and the United States Forest Service are responsible for administering millions of acres of federally owned range and forest lands, as well as coping with the public's demand for increased recreational opportunities.

Who Manages Our Public Lands?

BACKGROUND FOR **TEACHERS**

The other federal agency that protects some of the most unique marvels in the country — and in the world—is the National Park Service. Here in Colorado, there are:

~ Cliff dwellings and ancient pueblos at Mesa Verde National Park, a World Heritage Site;

~ High peaks and glacial valleys at Rocky Mountain National Park;

~ Awe-inspiring collections of ancient bones at Dinosaur National Monument;

~ Shifting sands and tall dunes at Great Sand Dunes National Park;

~ Remarkably preserved plant and insect fossils at Florissant Fossil Beds National Monument;

~ Historic military and trading posts at Bent's Old Fort National Historic Site;

~ Canyons and rushing waters at Black Canyon of the Gunnison National Park;

~ Sparkling waters of Curecanti National Recreation Area.

Last, but certainly not least, is Colorado National Monument, a geologic gem in this spectacular collection of national parks, monuments, recreation areas, historic and cultural sites, battlefields, memorials, wild and scenic riverways, lakes and seashores.

Many people are familiar with the words "national park". Images of wonders from national parks adorn books, calendars, and magazines. Advertisements for cars, clothes, cameras, and outdoor equipment spotlight national parkland settings to enhance product sales. Countless movies, from westerns to "Thelma and Louise" to "Close Encounters of the Third Kind", utilize these sites as backdrops to or elements of the plot. In spite of all this exposure, few people actually know the history of the National Park Service and the principles on which it was founded.

This chapter of the *Adventures in Colorado National Monument: Teacher's Guide and Activities* goes beyond the scenery to focus on both the past and the present of this venerable and visionary institution. The treasures managed by the National Park Service give insight into the dreams and hopes of our fledgling nation that were bound with the commitment to preserve some of the unique wild places that were discovered in our westward expansion. Issues faced by the National Park Service today exemplify the challenges of land and resource management, recreation, preservation, and environmental protection faced around the globe. It also offers a useful introduction to other city, state, and federal land management agencies.

The National Park Service
Origins and Issues

BACKGROUND FOR **TEACHERS**

- Hot Springs
- Giant Sequoias
- Geysers
- Waterfalls
- Canyons
- Caves
- Volcanoes
- Alpine Tundra
- Beaches
- Grasslands
- Mountains
- Forts
- Battlefields
- Cliff Dwellings
- Fossil Beds

These are just a few of the unique and scenic resources across the country that have been preserved and protected as national parks, monuments, and historic sites.

Formally established in 1916, the National Park Service has roots that go back to the very beginnings of the United States. In its history are ethics, issues, and questions that touch deep values and involve complex challenges for the future.

America's Wonderlands

When America was young, its connections to the "Old World" were still strong. Many people felt the culture and history of Europe was superior to that of the "new world." As westward explorations and expansion revealed marvels in the wilderness, attitudes began to change. A sense of pride, worth, and patriotism took hold. In America's natural places were scenic wonderlands that inspired and awed: the waterfalls and rock domes of Yosemite Valley; the groves of giant sequoias of the Sierra Nevada; the mud pots and geysers of Yellowstone; and the canyons of the Colorado and Green Rivers. The combination of breathtaking landscapes with seemingly unlimited economic opportunities lured citizens across the country with hope and possibility in their hearts.

The National Park Service
Origins and Issues

BACKGROUND FOR **TEACHERS**

Origins

As tales of the grandeur, the vastness, and the uniqueness of these lands spread, so did the desire to make money off of these areas of scenic splendor. Stories of the unparalleled beauty of Yosemite Valley and its waterfalls sparked interest in what else America's public lands might contain. An exhibit of bark stripped from one of the largest sequoia trees in the Calaveras Grove stirred public controversy as much as curiosity. The result was that in 1864, Congress took its first steps toward protecting natural wonders within the "public domain". It set aside eight square miles of Yosemite Valley and the nearby Mariposa Grove of giant sequoias as a preserve to be administered by the State of California. As such, Yosemite was "for all citizens 'to be held for public use, resort, and recreation…and be held inalienable for all time.'"

In the Heart of Yellowstone

More and more people came west, and lands were settled and divided. Questions of ownership, property rights, and values came to the forefront. Who had the right to purchase and settle? Was it those with plenty of money and influence, or were small homesteaders and immigrants going to have a chance as well? Did any one person or corporation have the right to profit from the amazing sights and natural phenomena that were found? Or should these wonders be owned by everyone in the national interest? Topics such as these were discussed around a campfire deep in the heart of Yellowstone in 1870. A small group of explorers and army personnel, known as the Washburn-Langford-Doane expedition, contemplated the geysers, mud pots, boiling and bubbling hot springs, and deep canyon cut by the Yellowstone River. Of their venture into the vast wilds of that region, Lieutenant Gustavus Doane wrote: "As a country for sightseers, it is without parallel; as a field for scientific research, it promises great results;…it is probably the greatest laboratory that nature furnishes on the surface of the globe." What lay before these adventurers was so remarkable that they considered it worthy of becoming a treasure of the nation as a whole, instead of being controlled by an individual, corporation, or group. Efforts to forge the first "national park" thus began.

The National Park Service
Origins and Issues

The First National Park: Yellowstone

The idea of protecting areas with unique resources and scenery within the public domain gathered more support. Letters, speeches, and eloquent persuasions by the Yellowstone explorers and others across the country culminated in Congressional action. In 1872, two million acres of public lands were withdrawn from settlement and development, and given the special federal designation of Yellowstone National Park. The lands were set aside for preservation, maintained in their "natural condition", and retained as "public park, or pleasure grounds, for the benefit and enjoyment of all the people". Such legislation and public involvement heralded a new era of governmental action to find value beyond that of economics within the land.

In the years that followed, other wonders were set aside as national parks. These included Mackinac Island in Michigan (now a state park); Sequoia and General Grant (now Kings Canyon National Park) in California; Mount Rainier in Washington; Crater Lake in Oregon; Wind Cave in South Dakota; and Mesa Verde in Colorado. Yosemite was formally transferred from state administration to national parks in 1906. In all instances, large tracts of land with outstanding scenic or remarkable cultural features in their landscapes were set aside by the government to become part of the national heritage. Commercial use of timber, minerals, grass, and water was prohibited, as the lands were to be owned by the nation as a whole, and the resources conserved for the good of everyone. Yet, in spite of their new legal status as national parks, the parks were given little money, staff, or equipment for development or protection. The next stage in the debate about the value and importance of federally managed lands began.

The Antiquities Act of 1906 and the First National Monuments

Further explorations of western lands revealed the cliff dwellings and archeologic ruins in the canyons and mesas of the desert southwest. Congress was inspired to pass the Antiquities Act of 1906. This legislation was significant for two reasons. First, it prohibited any person from the "appropriation, excavation, injury, or destruction of any historic or prehistoric ruin or monument or any object of antiquity on lands owned or controlled by the Government of the United States, without permission of the department with jurisdiction over those lands." Countless prehistoric sites, historic buildings, and other cultural locales benefited from protection under this act. Even today, it continues to be a very important piece of legislation.

A second and equally important facet of the Antiquities Act gave the President of the United States the executive authority to declare national monuments on existing federal lands. National monuments were distinct from national parks in that they were established to conserve areas or structures of historic, scientific, or national interest without going through the Congressional legislative process. Instead, the President alone could proclaim an area of existing public land to be significant enough to warrant this special federal protection. Thus, the first national monument to be created was Devils Tower, a fluted column of volcanic rock rising nearly 1000 feet above the Wyoming desert. Muir Woods, El Morro, Chaco Culture, and Petrified Forest National Monuments followed, a redwood grove, a rock inscribed in 1605, the ruins of an ancestral Puebloan community, and a fossilized forest respectively.

The National Park Service
Origins and Issues

BACKGROUND FOR **TEACHERS**

Colorado National Monument was added to the growing group of national monuments on May 24, 1911. President William H. Taft designated it because "the extraordinary examples of erosion are of great scientific interest, and it appears that the public interest would be promoted by reserving these natural formations as a national monument, together with as much public land as may be necessary for proper protection thereof."

The Formalization of the National Park Service

As the number of parks and monuments expanded across the United States, the need to allocate funds for their maintenance and preservation also grew. Although public interest in parks steadily increased, the sites were still cared for and protected by limited staff, with little coordination between areas. Colorado National Monument, for example, had a single custodian to undertake and coordinate development of trails, roads, camp and picnic grounds, and facilities on many acres. In addition, different federal agencies, with diverse philosophies and goals, oversaw the parks. While the Department of the Interior managed some parks, the Department of Agriculture (United States Forest Service) and the Department of War administered others. To protect resources, confront poachers, fight forest fires, and improve road access, larger parks, such as Yellowstone, utilized manpower from the military. For a number of years, Yosemite and Sequoia both had superintendents who were army officers.

With divergent images of what constituted a national park, and differing philosophies of management, many sites faced new challenges and ethical dilemmas. Should resources in parks be given an economic value in the name of progress? What reason was there to protect park resources when they could be put to "use" by corporations and developers? What was going to serve the largest number of people in the best way? Timber was at issue in the Pacific Northwest. Grazing rights were the focus around Yosemite. The right to water caused the biggest debate of all. Should rivers be tapped for irrigation, power, and domestic use, or allowed to run free? This conflict reached an apex in 1913 when Congress permitted the damming of Hetch Hetchy Valley near Yosemite. Discussions about the value of park resources, to utilize or to preserve them, reflect the mixture of attitudes about who has the rights to ownership and development of park assets across the country. The passage of time has not resolved these issues. Similar challenges still exist in the park system today, most notably around Yellowstone, Redwood, and Everglades National Parks, many Alaska national parks, and in the newly created Grand Staircase-Escalante National Monument in Utah.

In 1916, Congress established the National Park Service as an administrative bureau within the Department of Interior. This new agency was given sole responsibility for parks nationwide. Its mission was to manage the existing 35 parks and monuments (as well as any others that were created in the future), to take over operation of parks and monuments from other departments, to obtain funding for the park development and use, and to create policies for overseeing these treasured national lands.

Further, the agency was mandated to "conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." For over 80 years, this vision has directed the actions of the National Park Service.

Now, over 380 sites across the country have been set aside as "outstanding or rare examples of geologic landforms or biotic areas, places of exceptional ecologic or geologic diversity, sites with a concentrated population of rare plant or animal species or unusually abundant fossil deposits, or an outstandingly unique scenic or cultural value" for the benefit and enjoyment of the public. Besides national parks and national monuments, national historic sites, national recreation areas, national seashores, national lakeshores, national scenic trails, wild and scenic rivers, battlefields, and memorial parks have been preserved from coast to coast. Not only are photographers, artists, poets, writers, and adventurers enriched by visiting these places, but people of all ages, heritages, and interests seek out parks for relaxation, learning, and inspiration. America's commitment to conserve its memorable scenery and history has stimulated other nations to protect their natural and cultural wonders as well.

No Park is an Island

Many other issues and challenges face the National Park Service. In the last thirty years, environmental awareness has grown around the globe. Recognition of the diversity and interconnectedness of life has skyrocketed. As a result, managers must carefully assess resources within their parks, as well as view them in the context of natural systems that often extend miles beyond park boundaries. Rather than simply preserving the scenic values of individual parks, a new vision of national parks as part of larger plant, wildlife, and human communities is evolving.

Forest fire management policies demonstrate this challenge. At Sequoia National Park, forest fires represent an enormous threat to the towering big trees. What, then, is the role of fire in a national park? Should there be policies of complete suppression? Or can small, carefully monitored fires eradicate forest debris and lower-growing plant species, that might cause really hot, destructive fires if left unburned? Scientific investigation of fire ecology brought about policy changes in the mid-1970's whereby fire was viewed as having a valuable role in keeping ecosystems healthy. Fires caused naturally, such as by lightning, were permitted to burn as a means of ecologic restoration and revegetation. Fires caused by humans; fires threatening historic or other structures; or fires in areas of irreplaceable resources, were to be suppressed. In some areas, controlled burns, set by firefighters themselves when weather and other conditions were right, were found to improve habitat for sequoias, as well as other plants, animals, and humans.

However, in the summer of 1988, when fires swept from Yellowstone National Park into lands outside, the region, both physically and economically, was threatened. In this case, Yellowstone did not stand alone; it was part of a broader community of private and public interests. Existing National Park Service fire fighting policies were disputed by area residents directly affected by the smoke and destruction, as well as by those who questioned the impacts of fire upon park resources. Ultimately, Park Service fire management tactics were vindicated, but fire and park officials could no longer view their actions within the park as ending at the park boundary fences. Instead, they had to work with neighbors, and with the public as a whole, to improve communication, and to educate about the positive role of fire in natural ecosystems.

Fences and boundary markers cannot contain other outside threats to the so-called "natural condition" of the parks. Plant species that do not originate in the environment can be introduced and thrive. At Colorado National Monument, tamarisk, a ten to fifteen foot high shrub, grows in many drainages and canyon bottoms. In spite of its abundance, tamarisk is not a native species. Introduced in the 1800's, it has spread rapidly throughout the west. Growing in dense, almost impenetrable thickets, it can out-compete willows, cottonwoods, and other water-loving native vegetation. In order to protect plants indigenous to the Colorado National Monument, the National Park Service has had to develop programs to eradicate it within its borders.

Non-native wildlife, threatened and endangered species, water and air pollution, acid rain: there are many other threats to the national park system. No park is an island unto itself. It is very much a part of our global ecosystem, and very much a part of all of us.

Now and Into the Future

The number of new parks to be included in the National Park Service may not increase in the next decades, but the issues facing the existing national treasures seems to grow exponentially. As the agency moves into the twenty-first century, environmental awareness forces park managers to look more carefully and scientifically at their scenic and cultural resources. The rights of private citizens, state, local, and federal governments to and in these nationally protected lands continues to be negotiated. The fluctuating demand for the economic value of timber, oil, gas, and water influences development pressures on parks. How are the needs of the nation best served — by extraction or by conservation of resources? Assuring the original mandate of the National Park Service, that lands be conserved "unimpaired…for future generations" may be one of the highest hurdles to be achieved.

How much our parklands are valued and in turn visited may be the ultimate challenge to the National Park Service. Coping with the tremendous number of park visitors desiring a memorable experience, as well as expecting safe, comfortable and accessible conditions, requires personnel, facilities, and money that are in short supply. Another hurdle is how to safeguard irreplaceable cultural, historic, natural, and scenic features from impacts of this high visitation. As people build homes and industries adjacent to parks, as our populations grow, and as more and more people come to parks for recreation and enjoyment, park habitats are increasingly impacted. Whether it be from littering, trail erosion, cryptobiotic soil crust destruction, development of accommodations for park visitors, or simply overcrowding on trails and campsites, disturbances to natural resources in the parks grow daily. It seems that in our love of parks and experiences we have in them, we visitors are degrading the places we value most. It behooves all of us to tread lightly and thoughtfully in our national parks, and to remember that these magnificent places belong not only to us, but to "future generations" of Americans who will also want to experience them to the fullest.

Behind the Scenery
Colorado's Other Parks and Refuges

BACKGROUND FOR **TEACHERS**

Colorado is well known for its scenic beauty. People come from all over the world to visit its Rocky Mountains, grand lakes, rushing rivers, and historic cliff dwellings and mines. Many private organizations as well as city, state, and federal agencies seek to cultivate and preserve the state's landscape and natural resources. While some work on behalf of wildlife and plants, others strive to create accessible recreation acceptable for people of all ages and abilities. Still others have a mission to promote multiple uses of land, including logging, mineral development, grazing and recreation. Because these groups manage diverse lands, with different guidelines, park users are faced with an array of regulations. What is acceptable in one location is not permitted in another. In order to be responsible visitors, both children and adults need to become familiar with the unique land use plan for the park that they are visiting.

Private Organizations

The Nature Conservancy, the Trust for Public Land, the Colorado Coalition of Land Trusts, and the Mesa County Land Conservancy are some of the private groups successfully managing thousands of acres of land in Colorado. Through donations of ranch land, river bottoms, grasslands, forests, wetlands, and other types of open space, they seek to preserve habitat that plants, animals, and natural communities need in order to survive, and to sustain the diversity of life on Earth. With tools such as cooperative agreements and conservation easements, these groups actively work with individual landowners seeking to protect unique or important tracts of land on behalf of wildlife or plant life. Because most of the lands are held privately, special arrangements must be made for the public to visit them.

City Parks

Most cities have at least one piece of land set aside as parkland within their boundaries. Centrally located open spaces have been part of the design of villages and clusterings of homes since ancient times. Remnants of public areas are found worldwide, including plazas in cliff dwellings in America, circular cities in Turkey, and gardens in Japan. One of the first American city parks was established in the 1850's in New York City. This one square mile of land, known as Central Park, gave local residents land for recreation, and a place to escape the bustle of city life. Today, open spaces for public recreation are a key element in the development of urban areas.

Behind the Scenery
Colorado's Other Parks and Refuges

Easy access to recreational opportunities is a characteristic of city parks. Grand Junction has thirty-four city parks within a short distance of most residents. The Grand Junction Parks and Recreation Department manages and maintains these areas, together with more specialized sites, such as soccer and baseball fields, skateboard and rollerblade parks, hockey rinks, basketball and volleyball courts, and lighted tennis courts. Emerson, Pomona, Hawthorne and Columbine are some of the parks with picnic facilities and children's playground equipment. Lincoln Park offers golf and an outdoor swimming pool, while Blue Heron and Watson Island have trail systems for bicycling, jogging, walking, even bird watching and fishing. The diversity and quantity of city parks makes Grand Junction a pleasant place to live and work.

State Lands

While city parks exist within neighborhoods and are easily reached, lands owned by the State of Colorado may be near urban areas or in more remote settings. Three types of land are managed by the state for the benefit of its residents: state school trust lands, state parks, and state wildlife areas. Each one has a unique mission that directs the way it is operated and how it is used by the public.

State School Trust Lands

State school trust lands are the oldest, but least known, of the land management agencies. Beginning with the General Land Ordinance in the 1780's, and continuing until Alaska became a state in 1959, the United States Congress granted statehood with certain conditions. One requirement was that specific sections of land be set aside as "state school lands". These were to be held in trust for the benefit of schools within each state. When Colorado achieved statehood in 1876, its enabling legislation from Congress authorized that "sections 16 and 36 in every township…are granted to the state for support of common schools. These two sections shall be disposed of only at public sale…the proceeds to constitute a permanent school fund, the interest of which to be expended in the support of common schools."

Today, the Colorado State Land Board administers both the state school trust lands and the funds that they generate. The state owns 2.8 million surface acres, and over 4 million mineral acres. Many of these properties are leased out to a variety of individuals and companies. Fees charged for use of these properties bring in revenue for the state. For example, rights of way; oil, gas, coal and other mineral development; agricultural uses; forest product sales; grazing rentals; and periodic sale of the lands, all generate income. These monies are distributed annually into other trusts that are managed for schools, the Colorado State University system, and the University of Colorado. In addition, public buildings, penitentiaries and state parks also benefit . Thus, thanks to far-sighted Congressional mandates, State of Colorado owned lands have many uses, one of which is to bring in funds that ultimately go to public education, public parks, and public facilities.

Behind the Scenery
Colorado's Other Parks and Refuges

BACKGROUND FOR **TEACHERS**

State Parks

State parks are perhaps the best known and most appreciated of the state land management agencies. The concept of state parks began in 1921 with a gathering of conservationists, politicians, and state officials from around the country. Calling themselves the National Conference of State Parks, these visionaries urged that state, county, and local governments acquire land and water to develop for public recreation, as well as for wildlife habitat. The result of their efforts, together with those who financed, acquired, designed, and constructed the facilities, was the creation of parkland in each state. One reason for the state parks was, and still is, to help people to get away from the congestion and flurry of cities, and into greater contact with nature. Now a multitude of recreational opportunities are offered in the state parks, including biking, boating, camping, fishing, hiking, picnicking, wildlife observation, and other leisure pursuits in the out-of-doors.

Established in 1957, Colorado's state park system operates parks for the benefit of public recreation. Today, over 40 parks encompass 160,000 acres of land, and 46,000 acres of surface water statewide. Many locations were originally reservoirs created for water storage, agricultural irrigation, flood control, or hydro-electric power generation. The Department of Parks and Outdoor Recreation (DPOR) acquired lands around these waters, and developed them for another use — recreation. Now, boat houses, marinas, picnic areas, campgrounds, fishing piers, beaches, hiking and biking trails, and many more facilities exist alongside these reservoirs. The concept of multiple use of resources for the public good has been highly successful, with over twelve million people reportedly using the state park system annually.

In the Grand Junction area are Vega State Park, Highline State Park, and the Colorado River State Park, which encompasses Island Acres, Corn Lake, Connected Lakes and Fruita. Revenues for development and maintenance of the Colorado State Parks come from several sources. Some are generated by the State School Trust Lands; other funds come from taxes, fees, Great Outdoors Colorado, and the Colorado State Parks Foundation.

Wildlife Areas

The Colorado Division of Wildlife (DOW) is another of the state's land management agencies that benefits not only Colorado's human population, but its plant and animal life too. It oversees lands principally for wildlife and habitat, and secondarily for recreational purposes. Over 350 State Wildlife Areas totaling over 650,000 acres within the state are operated with the slogan, "For Wildlife, For People." The scope of DOW lands is impressive, supporting a wide variety of birds, reptiles, amphibians, insects, spiders, and mammals. Included are large tracts of habitat for elk and big game, as well as smaller sites where fish are hatched and reared for stocking. Some DOW sites close seasonally to allow wildlife to breed, nest, raise their young, or be protected from human interactions. At other times, the lands are open for public recreation, hunting and fishing use. More and more opportunities for wildlife watching are available for those interested in nature observation.

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In contrast to other government agencies funded entirely by taxes, 76% of DOW revenue comes from fees for fishing and licenses for hunting. The remaining income is from fines and penalties, and taxes on the sale of sporting goods. While Great Outdoors Colorado contributes approximately 3% of the budget, the Nongame Checkoff on Colorado State Income Tax forms contributes a mere 1%. DOW expenses include fish hatcheries, stocking of fish in reservoirs and streams, management of wildlife and habitat, endangered species protection, and efforts by the DOW to be a steward of the state's wildlife resources now and in the future. State Wildlife Areas in Mesa County are Horsethief, Loma Boat Launch, Plateau Creek, Walker, and West Lake.

Thus, the state of Colorado has a broad spectrum of land management agencies that work behind the scenery to care for natural resources and to serve its residents.

Federally Managed Lands

Management of millions of acres of open space across the United States is divided up among many federal agencies: the United States Forest Service (USFS), the Bureau of Land Management (BLM), the National Park Service (NPS), the Bureau of Indian Affairs (BIA), the Bureau of Reclamation, the United States Fish and Wildlife Service, the Department of Energy, and the military. Almost every state in the country has parcels of land that belong to the United States Government. Three land management agencies, the Forest Service, the Bureau of Land Management, and the National Park Service, will be discussed here, because they oversee significant public lands in Mesa County.

With so much land across the western United States under federal control, land management by government agencies is a highly charged topic to many people.

Moreover, the roots of the controversy go back to the very beginning of the United States. From the late 1700s to the late 1800s, the nation was low on funds, but had more than enough land as "public domain." Much of this land was wilderness, unexplored, and untouched by humans. To raise money, and make new homes available to citizens, the government encouraged the sale of tracts into private hands for settlement. Huge sections were sold to individuals and corporations for grazing, timber, mineral, and agricultural development. As a result, the government disposed of over two-thirds of its 1.8 billion acres of land into private or state ownership and management in a remarkably short period of time.

By the late 1800s, western lands were nearly divided up. Competition for public lands grew. Fraud, monopoly, and speculation created tumult in the General Land Office. Degradation, pollution, and over-consumption of water, timber and grasslands increased. These conditions generated interest in conservation and regulation of the remaining public land resources. Protection of Hot Springs, Arkansas from development; preservation of Yosemite as a state park in California; and designation of Yellowstone as a "public park, or pleasure ground, for the benefit and enjoyment of the people," set the scene for the federal government to take on the new role as caretaker of valuable or irreplaceable resources, instead of being a distributor.

Behind the Scenery
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BACKGROUND FOR **TEACHERS**

In 1891, to protect rapidly diminishing timber lands, Congress authorized the first forest "reserves" and the establishment of a Department of Forestry (later Forest Service) within the Department of Agriculture. Momentum to set aside timber reserves grew as President Theodore Roosevelt stated his desire to see public lands developed with the "highest use for the greatest good". As a result, Congress granted him the authority to withdraw public land from settlement temporarily, without congressional action, while its most appropriate use was determined. By 1934, when the famed Taylor Grazing Act was approved, the first grazing districts, overseen by the Department of Interior, were formed on unclaimed and unsettled federal land. Thus, the disposal of land into private ownership began to end, and the government's role as a land manager expanded. The removal of land from settlement and possible development created dissension. The seeds of controversy over private versus public rights to federal land ownership and management were also sown.

In response to opposition to the growing federal forest reserves, Congress created revenue-sharing programs between the states and the forests. A portion of the funds from timber sales was to help pay for construction of roads, trails, and schools, a program that continues to this day. The two World Wars and their aftermath triggered huge demands for timber and mineral production. At the same time, citizens began to seek increased outdoor recreational opportunities. The rights of states, corporations, individuals, as well as the federal government, to control what happened on public lands, and to benefit by any resources on it, caused much debate. Juggling diverse demands on publicly owned lands was not easy — nor will it ever be. Still, it led to a necessary streamlining of policies and organization, much of which is still in effect.

Today, the federal government has distinct missions for its three largest land management agencies. While boundaries may meet, uses and regulations change depending on which side of the fence one is standing.

The United States Forest Service, a division of the Department of Agriculture, oversees millions of acres of lands under the guidelines of multiple use and sustained yield. One acceptable use of the land is economic. This means that natural resources are managed as a farmer would crops: to be grown and cared for to guarantee harvest and availability for human use for the long term. Thus, because people need wood for construction and other uses, logging of selected areas of timber by contractors, and seasonal wood cutting by individuals with a permit, are acceptable. Drilling for oil and gas, and mining for coal is allowed in order to meet the demand for fossil fuels. The market for beef, lamb, and wool warrants use of forest meadows and grasslands for grazing, while interest in hunting for deer and elk results in fall hunting seasons on forest lands. The need for water for irrigation, flood control, and power dictates damming of streams and rivers.

Another significant "use" of forest lands is recreation. The public's interest in opportunities for camping, hiking, picnicking, fishing, hunting, skiing, snowmobiling, and boating has led to developments to meet these needs. Visitors to the national forests enjoy a wealth of activities, both active and quiet, in forests across the country. In this region, the Grand Mesa, Uncompahgre, Gunnison, White River, Manti-LaSal, and San Juan National Forests all offer outstanding recreational opportunities, as well as permit a variety of other more economically based uses on their lands.

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The concept of "multiple use and sustained yield" evolved from utilitarian roots, and the United States citizenry has benefited enormously from it. With increasing environmental awareness, and appreciation for the need for large, unbroken tracts of forest for plant and animal life, controversy over limits on the uses, and over-uses, of the nation's forests grows. As with so many land use questions, there is no simple or easy answer, and certainly the debate will continue over "appropriate use" of the resources.

The Bureau of Land Management (formerly the Grazing Service) is a land management agency within the Department of Interior. Together with the U. S. Forest Service, it is estimated to administer over 80% of federal lands. It is in charge of over 270 million acres of land, which it also manages and leases for sustained yield and multiple use. Many of its parcels are from the federal government's original "public domain", being too remote, harsh, inaccessible, or uninhabitable to have been settled or designated as national forest or park land. Grazing, oil and gas exploration, coal mining, and other extractive ventures may be found on its lands. Recreational visits to BLM land are increasing as people seek more solitary and remote adventures than can be found in some of the nation's forests and parks. As discoveries of the lesser known beauties and resources on BLM lands are made, these lands will experience more recreational use by the public. Because some of these lands are less regulated than national park lands, the need to protect them also grows. In this region, Big Dominguez, Miracle Rock, Lower Dolores Falls, and Mud Springs Recreation Areas are all managed by the Bureau of Land Management, as are vast tracts of land in south and eastern Utah.

The National Park Service, another division of the Department of Interior, manages hundreds of national parks, monuments, recreation areas, historic and cultural sites, battlefields, memorials, park and riverways, lake and seashores across the country. In contrast to the Forest Service and the Bureau of Land Management, its mandate is to preserve and protect lands of "national significance" into the future. Its mission is to "conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Whereas a tree in the national forests represents potential economic value, that same tree on National Park land would live, die, decay, and recycle its energy and nutrients back into the environment unhampered by human intervention.

Colorado hosts a surprising number of the National Park Service units. These include Colorado National Monument, Rocky Mountain National Park, Mesa Verde National Park, Dinosaur National Monument, Black Canyon of the Gunnison National Park, Curencati National Recreation Area, Great Sand Dunes National Park, Hovenweep National Monument, and Bent's Old Fort Historic Site. Arches and Canyonlands National Parks, Rainbow Bridge National Monument, and Aztec Ruins National Cultural Site are all nearby as well.

Together, and day by day, city, state, and federal land management agencies work beyond the scenery, creating opportunities for public recreation, and stewarding the nation's resources and lands into the future.

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Age Level

5th through 8th grades.

Purpose of the Activity

The purpose of "These Lands Are Your Lands" is twofold. First, students learn about the diversity of parks, monuments, historic and other sites that are preserved across the country by looking at maps of the United States. Next, they test their knowledge about federal lands and regulations in a national parks quiz. Two optional exercises are also included in this activity. In one, students are challenged to create and plan their own national parks. In the other, the class writes imaginary letters to Congress proposing their "parks" for inclusion within the National Park Service. These four elements fit together to form an interactive curriculum about a federal agency that has great meaning and importance across the nation.

Amount of Time Required

One to three hours are needed for this activity. Because there are four individual sections to this exercise, they can be done separately or together over several classroom periods. Since each activity builds on the other, an entire morning could potentially be devoted to "These Lands".

Best Location

Classroom.

Materials Needed

- ☐ Atlases of the United States, on which national parks, monuments, historic and cultural sites, and recreation areas are shown. They do not have to be new to be useful in this activity. A brand widely available is the "Rand McNally Road Atlas". One atlas for every two to three students is recommended.
- ☐ Copies of Worksheets #1 and #2 — for each student.
- ☐ Copies of "Teacher Answer Guide" that accompanies each worksheet in this activity — for the teacher's reference.
- ☐ Copies of "Beyond the Scenery" and "The National Park Service: Origins and Issues" from the background information section of this chapter — for the teacher's use.

For the optional activities, a pencil and several blank sheets of paper are needed for each team of students.

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Background Information

"These Lands Are Your Lands" is composed of two main activities and two optional ones. Each section builds upon information and knowledge gained previously. The parts are also structured to stand on their own. There are sites to locate, discoveries to make, questions to answer, and issues to consider. "Worksheets" for students and "Answer Guides" for teachers provide challenges, information, and guidelines for study. Thus, the teacher may follow the activity through step-by-step, or craft a lesson plan from the separate elements to meet his or her curriculum needs. A brief description of each part of "These Lands Are Your Lands" follows.

Part One: Atlas Scavenger Hunt

Part One of "These Lands Are Your Lands" is a scavenger hunt about the national park system. Students use atlases of the United States to find a variety of National Park Service sites around the country. From Hawaii and Alaska, to Wisconsin and North Carolina, students seek out places that are well known, as well as others that are more challenging to locate. That so many places around the country have been protected because of their scenic, cultural, or historic value is impressive for children. Discovering the diversity of parks and their wide range of settings is fun and informative for them. This scavenger hunt leads into the next part of the activity which takes a more in-depth look at the National Park Service.

Part Two: These Lands Are Your Lands

Part Two of "These Lands Are Your Lands" is a quiz about the National Park Service. Students must find the answers to a range of questions, from who owns the national parks, to how do national parks and monuments differ, to what regulations do users of the national parks need to know. Contrasts between national parks and national forests are also considered. Material in this segment gives students and teachers alike a better understanding of and appreciation for the many kinds of parks and open space around our country.

Part Three: Make Your Own Park

Part Three, "Make Your Own Park", is optional, and intended for grades seven and eight. In it, students work in teams to develop and plan out parks of their own. These sites may be real or imaginary, but they must have features so unique or special that they can be considered for federal protection and preservation as national parks or monuments. A worksheet helps the teams to outline the reasons that their particular sites meet criteria for this designation. Another component of Part Three is planning for the development of their parkland, from acquiring it to opening it up to the public.

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Part Four: Write Your Congress

Part Four, the other optional component of the "These Lands Are Your Lands", asks students to write an imaginary letter to Congress proposing their lands for inclusion in the National Park Service. Even though their "parks" are not real, through this exercise, children parallel the process by which national parks and monuments are actually created.

Creation of Colorado National Monument

For example, Colorado National Monument was the vision of a number of Grand Valley residents, including the legendary John Otto. In the canyons, monoliths, and geologic features of the neighboring mesa, these people saw a place so marvelous and rare that it should be preserved for generations of people to learn from and visit. They petitioned and wrote to Congress, sent letters to the newspaper, and raised funds in order to reach their goal of making the land a national park. It was no small undertaking. Getting such a designation required vision, leadership, commitment, perseverance, and enthusiasm in the face of the challenges of the political process. In this case, however, the United States Congress did not act to create a new national park.

In 1911, President William H. Taft did act. He utilized executive powers granted to him under the Antiquities Act of 1906 to protect the lands as a national monument. In his Presidential Proclamation, he stated: "The extraordinary examples of erosion are of great scientific interest, and it appears that the public interest would be promoted by reserving these natural formations as a National Monument, together with as much public land as may be necessary for the proper protection thereof."

Curriculum Standards

Thus, the four parts of "Make Your Own Parks" not only teach students about the National Park Service as a whole, but they give a first-hand look into the complexity and challenges of land use planners. Through this activity, the class is introduced to the remarkable diversity of lands that have been preserved nationwide. In addition, by writing imaginary letters to Congress, students learn lessons about the democratic process, and about how to "exercise their rights and responsibilities of participating in civic life". The latter is a Social Studies (Civics) Curriculum Standard for grades 5 through 8.

Please note that "These Lands Are Your Lands" culminates with the two optional activities. Because of the analysis and writing required in these activities, they are recommended for older students in grades 7 and 8 only.

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In order to make "These Lands Are Your Lands" go smoothly for the class, the teacher needs to read and be familiar with the Background Information about the National Park Service and other land management agencies provided in this chapter. She or he should make a brief presentation to the class about what the National Park Service is and does. How it is similar and different from city parks, state parks, the United States Forest Service, and the Bureau of Land Management should also be included. Because this discussion is most effective when personalized, the teacher should tell a story about his or her own experience in a national park, or get students to share their adventures in one.

Lastly, the "Make Your Own Park" segment helps teachers and students to appreciate more fully their rights and responsibilities as park users. With Colorado National Monument; Black Canyon of the Gunnison National Park; Curencanti National Recreation Area; the Uncompahgre, Grand Mesa, and Gunnison National Forests; Bureau of Land Management lands; as well as numerous state and local parks nearby, area residents need to be familiar with the mandates and rules by which these different sites operate. Where hunting and fishing may be acceptable on some state lands, and seasonally in the national forests and Bureau of Land Management lands, such activities are not permitted in the national monuments. Similarly, taking rocks, fossils, or plants home, or cutting firewood, may be allowed on private lands, yet regulations strictly forbid such activities in the National Park Service. Visitors need to understand that as the agencies have different definitions, so, too, do they have different rules and regulations.

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Definitions

The following definitions will be helpful in completing the four activities in "Make Your Own Park".

What is a National Park?

National Parks have two important features.

1 First, they are large areas of land that have been set aside for preservation specifically to "conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." These words were written by Frederick Law Olmsted, Jr., a noted landscape architect of the late 19th century. His concept of conservation of scenery, that it should not be diminished in value, quality, or condition into the future, became a key component of the National Park Service Organic Act of 1916.

2 Secondly, a national park is created by an act of Congress. Both the House of Representatives and the Senate have to agree that an existing piece of government owned land is worthy of being set aside, by being so unique or special as to be preserved in the national interest. The process of making a national park begins with a group of citizens and organizations proposing a site for inclusion in the national park system. After Congressional subcommittees study their idea, legislation to create a park is developed. With its passage by both the House and Senate, the new national park is created.

Examples of well known national parks are: Yosemite, Yellowstone, Grand Canyon, Everglades, Rocky Mountain, and Mesa Verde National Parks.

What is a National Monument?

A national monument differs from a national park in size, purpose, and origin. First, a national monument is often (but not always) smaller than a national park. Usually it is a landmark or site that, first, is on federal land, and second, has significant enough scientific or historic value to be protected for future generations to learn from and enjoy. National monuments are amazingly diverse. They include: birthplaces and homes of important national figures (George Washington, Booker T. Washington); historic sites (Pecos, Bandelier, Effigy Mounds, Aztec Ruins); unique plant, topographic, or geologic landscapes (Devil's Tower, White Sands, Pinnacles, Dinosaur, Jewel Cave, Saguaro); and important national symbols, such as the Statue of Liberty.

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Where national parks require an act of Congress for creation, national monuments may be set up by Presidential Proclamation alone. Under the Antiquities Act of 1906, the President of the United States was given the executive authority to declare an area to be significant enough to warrant federal protection. Thus, many places of unique scenic, cultural, historic, and geologic importance and interest have been added to the national park system through presidential rather than congressional action. Grand Staircase-Escalante National Monument in southwestern Utah is one of the more recent national monuments. It was established in 1995 by President Bill Clinton.

Both national parks and national monuments are part of the National Park Service, and are open to the public to visit 365 days a year. Both receive federal funding each year from Congress. In recent years, entrance fees charged by individual sites have been returned to those same sites for internal use.

Comparison of National Parks and National Forests

The National Park Service Compared With the United States Forest Service

The National Park Service is often confused with another federal land management agency, the United States Forest Service. Although the National Park Service emerged out of the U.S. Forest Service it is a division of the Department of the Interior, whereas the U.S. Forest Service is a part of the Department of Agriculture. Another difference is that the two agencies are managed for different purposes: the National Park Service for protection and preservation of land "unimpaired into the future", and the U.S. Forest Service for "multiple use and sustained yield". Where mining, timber sales and logging, wood cutting, grazing, and hunting are acceptable on U.S. Forest Service lands, minerals remain unexplored and untouched, trees fall and decay in situ, and wildlife is hunted with binoculars, not guns, on National Park Service lands. The words of Robert S. Yard explain this concept well: "Our national park system is a national museum. Its purpose is to preserve forever…certain areas of extraordinary scenic magnificence in a condition of primitive nature…Recreation is not distinctive of the system. The function which alone distinguishes the national parks…is the museum function made possible only by the parks' complete conservation…Except to make way for roads, trails, hotels, and camps sufficient to permit the people to live there awhile and contemplate the unaltered works of nature, no tree, shrub, or wildflower is cut, no stream or lakeshore is disturbed, no bird or animal is destroyed." (Note: More information about these two agencies is available in the "Behind the Scenery—Colorado's Other Parks" and "National Park Service: Origins and Issues" found in the Background Information section of this chapter.)

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Conclusion

"These Lands Are Your Lands" is an activity that gives students and teachers alike the opportunity to look behind the scenery of their national parks to understand why and how they were created. Not only is this an exploration of civics, but it is a valuable lesson in how to explore more appreciatively nearby Colorado National Monument. Worksheets help to focus the students on the national parks as a whole, and to highlight differences between national parks and national forests. In Parts Three and Four, older students can explore what actually constitutes a national park, and how to plan to preserve its resources while making the land accessible to the visitor.

Step-by-Step Instructions for the Activity

Preparations

1 Send students home with a note asking if parents have any atlases of the United States that could be used in the classroom for a few days. Explain that the atlases need to be detailed enough that national parks, monuments, and historic sites are listed. Brands where each state is on a separate page are especially helpful in this activity. Rand McNally and other publishers often produce these annually. For classroom purposes they do not have to be new. Depending on the response, check other sources, such as other teachers in the school, friends, and family. Some people may be willing to make a donation of their atlas to the school. Other options for finding maps include the school library, the public library, the local Chamber of Commerce, or local bookstores.

2 Plan for one atlas for every two students, but three students can work together if need be. Any more students per atlas would be too many.

3 As the atlases come in, make sure that the name of the owner is clearly marked on each one.

4 About a week ahead of time, tell the class that they will be studying about their national parks. Ask them to think about an experience or adventure that they have had in a national park, national forest, state park, state wildlife area, or city park. They can even bring to class a photo of themselves in a park. If they do not have a photo, ask them to draw a picture to share their experience. Some students may be interested in writing short accounts of experiences they had in parks. These can be put together as a group book or class bulletin board about parks.

5 Make copies of Worksheet #1: "Atlas Scavenger Hunt" and Worksheet #2: "These Lands Are Your Lands" quiz for each student.

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6 Lastly, the teacher should review all the background information provided in this chapter about parks, and use it as a basis for discussion. The focus should be on what the National Park Service is and does. How it is similar and different from city parks, state parks, the United States Forest Service, and the Bureau of Land Management should also be included. Because this discussion is most effective when personalized, ask students about their experiences in parks. Questions like the ones that follow will be helpful in this dialogue.

- How many of you have visited a local park in the Grand Junction/Fruita area?
- How many people have a city park near their home?
- What is your favorite thing to do in the city park?
- How often do you visit your city park?
- Who has visited a national park before?
- Can you name any national parks, even if you have not ever been to one?
- Who has visited the most national parks in the class?
- How many students have gone to Colorado National Monument before?
- What is a difference between your city park and a national park? Observations might include size, facilities (soccer fields and swimming pools versus picnic grounds and open space), and how the city park has mowed grass and playgrounds whereas the national park is mostly natural. Also noteworthy is who you see in the parks, local residents and neighbors as compared to people from all over the country and the world at national parks.
- What is different about the rules between local and national parks? The teacher should make special note of how pets are not as welcome in national parks, and collecting of plants and animals is not permitted there either.
- Who has been to a national forest before?
- What are some of the differences between it and city and national parks? Naming a few national forests may be helpful to get the discussion going.

Questions such as these will help to spark interest in your discussion about the different kinds of parks.

These Lands Are Your Lands

ACTIVITY PAGE

7 Challenge students to identify whether a place that the teacher names is a city park, state park, national forest, national park or national monument. A few suggestions to work from are:

~ Yellowstone (National Park)

~ Grand Mesa (National Forest)

~ Lincoln Park (City Park)

~ Mesa Verde (National Park)

~ Black Canyon of the Gunnison (National Park)

~ Highline (State Park)

~ Colorado River (State Park)

~ Blue Heron (City Park)

~ Colorado (National Monument)

~ White River (National Forest)

~ Uncompahgre (National Forest)

~ Canyon View (City Park)

~ Emerson (City Park)

Then challenge the students to think of a national, state, or city park for you to identify. Students really like trying to stump the teacher.

8 You may want to prepare some definitions of parks using the materials provided in the Background Information section of this activity and the background information for teachers section that accompanies this chapter. Younger students may benefit by copying down the definitions after you write them on the chalkboard. Older students can take notes as you speak.

These Lands Are Your Lands

ACTIVITY PAGE

9 Discuss with the group what some rules for national parks are. On one column of the chalkboard, record what the students think the rules for park users are. In another column, list the regulations for national parks as shown on the Colorado National Monument map.

- ~ National parks belong to everyone.
- ~ Do not collect or disturb any rock, fossil, plant, or artifact.
- ~ Wildlife may not be hunted, trapped, or injured.
- ~ Do not feed any wild animal.
- ~ Pets must be leashed or otherwise physically restrained at all times. They are not permitted in public buildings, or with hikers on trails.
- ~ Firearms must be sealed, cased, broken down, or otherwise packed to prevent their use.
- ~ Camping and picnicking are allowed only in designated sites, or with a special permit.
- ~ All vehicles must stay on roads.

These Lands Are Your Lands

ACTIVITY PAGE

How to Do the Activity

1 Plan to use one class period for the introductory discussion of parks and the Worksheet #1: "Atlas Scavenger Hunt". If you prefer, you can have the discussion on one day and do the worksheets on another. The structure for this activity is very flexible.

2 Introduce "These Lands Are Your Lands" with a discussion about parks. To get an idea of how much students know about them already, ask the group to answer a selection of questions that you have developed from the information given in the Background Information and Preparation sections above.

3 After you complete the discussion about the city parks, state parks, national forests, and national parks, make sure that your group has comprehended the differences between them. You can test how much they know by asking them to identify which of the local parks you name is city, state, or nationally owned and operated. Suggested questions are given in the Background Information section above.

4 Either as a group, or working from the information provided with this activity, establish some definitions of parks. Also record what some of the rules in national parks are.

5 Divide the class into teams of two (or three if need be). Give an atlas to each group, and Worksheet #1: "Atlas Scavenger Hunt" to each person. Teams will work together to find the answers to the questions on the sheet, but each individual needs to turn in their own work.

6 As the groups work, the teacher should float from one team to the next to assist with any questions that come up. The "Answer Guide" given with the worksheet should assist with any difficulties or questions that arise.

7 After the teams complete the activity, they may continue on to Worksheet #2: "These Lands Are Your Lands". Alternatively, Worksheet #2 may be done as a separate activity, or done on a different day. The teacher's "Answer Guide" will again assist with any questions that might come up.

These Lands Are Your Lands

ACTIVITY PAGE

Extensions

Part Three of "These Lands Are Your Lands" is optional. Called "Make Your Own Park", students work in teams to develop and plan parks of their own. The sites they chose may be real or imaginary, but they must have features so unique or special that they can be considered for federal protection and preservation as national parks or monuments. Worksheet #3 accompanies this activity, and helps the teams to outline the reasons that their particular sites meet criteria for this designation. Another component of Part Three is planning for the development of their parkland, from acquiring it to opening it up to the public.

To begin, students should think of the most scenic, remarkable, or interesting piece of land they can imagine. This is their ideal place, something magical and marvelous to them. It can be a real location, or one that is imagined. In either case, the students should write down specific features that make it unique and significant to them. After composing that list, they then consider its location in the United States. Next, the team must draw a map of their site. Finally, the students must address the following questions:

- Who owns the land right now? (National parks have usually been created on existing federal land. If a site is on private land, how could it be arranged with the owner to have it become federal land?)
- What are the physical features on the property? (Streams, lakes, rivers, springs, wetlands, cliffs, canyons, hills, forests, deserts, meadows, etc.)
- What are the special resources that are worthy of federal protection and preservation? (Rocks, geology, caves, rivers, rare plants or animals, remarkable scenery, historic structures, etc.)
- What kind of work would be necessary to make the land safe and accessible to people? Is it fenced off and are the boundaries clearly marked? Where will water, power, sewer, and other utilities come from?
- What kind of services will be necessary for visitors to the site? Is there drinkable water nearby? Where will roads, trails, bathrooms, Visitor Centers, picnic areas, campgrounds be placed?
- How will you get money to pay for all of these things? (Keep in mind your site is to be of national significance and people from all over the country will want to come to see it.)

After completing these questions, students will have a much better concept of the complex work needed to create and manage a park. Hopefully, they will also appreciate the important job that park and land use planners have in making sure that a piece of land is developed for the general public to use and enjoy, while also protecting the natural resources on the land.

Part Four is another optional exercise. In it, students compose imaginary letters to their Congressional Representatives and United States Senators proposing their lands for inclusion in the National Park Service. Why action should be taken to preserve and protect the land must be clearly stated.

Atlas Scavenger Hunt:
Worksheet #1

ACTIVITIES FOR STUDENTS

Directions: Use an atlas to hunt for the answers to the following questions about parks and forests around the country. Then write down your discoveries in the space provided.

1) The first national park was created in 1872 in the state of Wyoming. It covered over two million acres, and is still one of the largest and best known of our parks. What is it?

_____

2) In the state of Washington, find a large national park.

_____

3) Find a national recreation area in the state of Utah.

_____

4) On the coast of North Carolina, find a national seashore.

_____

5) Locate a national lakeshore in the state of Wisconsin.

_____

6) Name two national memorials in Washington D.C.

_____

_____

7) In southeastern Pennsylvania is a national military park. What is it called?

_____

8) Can you find a national preserve in the state of Alaska?

_____

9) What is the name of a national park or a national monument in the state of Texas?

_____

10) Find two national parks in the state of California.

_____

_____

11) Find a national park or a national memorial in the state of Hawaii.

_____

Atlas Scavenger Hunt:
Worksheet #1

ACTIVITIES FOR STUDENTS

12) How many national parks can you locate in the state of Colorado? _____

What are their names? _____

_____

_____

_____

_____

13) In the southeastern part of Colorado is a national historic site. What is it?

(Hint: It is near the town of La Junta.) _____

14) There are four national monuments in the state of Colorado. Can you name three of them?

_____

_____

_____

_____

_____

_____

15) How many national forests can you find in the state of Colorado? _____

Name one. _____

16) Find two state parks near Grand Junction.

_____

_____

17) What is the name of a city park that you like to visit?

_____

18) Do you know of any other countries in the world that have national park systems?

_____

_____

_____

_____

Atlas Scavenger Hunt:
Answer Guide to Worksheet #1

1) Yellowstone became our first national park in 1872. While Congress set aside Yosemite Valley as a land grant to the state of California in 1864, it did not become a national park until 1890.
2) Three national parks in the state of Washington are: Olympic, Mount Rainier, and North Cascades.
3) Glen Canyon National Recreation Area is in Utah.
4) The national seashores in North Carolina are Cape Hatteras and Cape Lookout.
5) The national lakeshore in Wisconsin is Apostle Islands.
6) The Vietnam Veterans Memorial, the Lincoln Memorial, the Jefferson Memorial, the Theodore Roosevelt Memorial are all found in Washington D.C.
7) Gettysburg National Military Park is found near Gettysburg, Pennsylvania.
8) There are a number of sites in Alaska referred to as national parks and preserves. They include: Denali, Glacier Bay, Katmai, Lake Clark, and Wrangell-St. Elias.
9) Big Bend and Guadalupe Mountains are two National Parks in Texas. Alibates Flint Quarries and Chamizal are two national monuments in Texas.
10) Yosemite, Kings Canyon, Sequoia, Redwood, Lassen, Death Valley, Joshua Tree, Mojave and Channel Islands are all national parks in California.
11) Hawaii Volcanoes (on the island of Hawaii) and Haleakala (on Maui) are national parks in Hawaii. The U.S.S. Arizona Memorial (on Oahu) is the national memorial.
12) There are four national parks in Colorado: Rocky Mountain, Mesa Verde, Great Sand Dunes and Black Canyon of the Gunnison.
13) Bent's Old Fort National Historic Site is just east of La Junta, Colorado.
14) There are four national monuments in Colorado, including: Colorado and Florissant Fossil Beds. Dinosaur and Hovenweep/Yucca House are on the Colorado–Utah border with portions in each state.
15) There are 11 units of the U.S. Forest Service in Colorado. They are the Arapahoe, Grand Mesa, Gunnison, Pike, Rio Grande, Roosevelt, Routt, San Isabel, San Juan, Uncompahgre, and White River National Forests.
16) Close to Grand Junction are Colorado River State Park: Fruita, Island Acres, and Connected Lakes; Highline; Rifle Falls; Rifle Gap; and Sweitzer Lakes State Parks.
17) Some parks in the City of Grand Junction are: Canyon View, Columbine, Desert Vista, Duck Pond/Orchard Mesa, Emerson, Hawthorne, Lilac, Lincoln, Melrose, Pineridge, Riverside, Sherwood, Spring Valley, St. Mary's, and Veterans Memorial Parks. Look in the telephone book for more listings.
18) Kenya, Botswana, Zaire, Ethiopia, Tanzania, Malawi, Chile, Peru, Ecuador, Argentina, Guatemala, Panama, Costa Rica, Nepal, India, Australia and New Zealand are some of the countries around the world that have national park systems, in part inspired, organized and trained by our own National Park Service.

These Lands Are Your Lands:
Worksheet #2

ACTIVITIES FOR STUDENTS

Directions: These questions are about the different kinds of parks and open spaces nationwide and locally. Write down your answers in the space provided.

1) Who owns the national parks?

_____

2) Where does the money for the parks come from?

_____

3) Can national parks be sold or developed for different uses?

_____

4) Who takes care of the national parks?

_____

5) Fill in the Blanks. A national park is created by an act of _____.
A national monument is created by _____.
Both sites have _____ scenery or landmarks
that are of _____ importance or interest.

6) What are some rules that you should remember when visiting a national park?
1. _____
2. _____
3. _____

7) Think of two things that MAY happen in national forests that cannot be done in national parks?
1. _____
2. _____

8) Can you name another federal agency besides the National Park Service that manages land in the United States?

_____

9) What other national park, monument, or other site in the national park system have you visited, or would you like to visit?

_____

10) What do you think makes your park so special? Can you think of a reason why it has been set aside for protection in the National Park Service?

_____
_____
_____
_____

These Lands Are Your Lands:
Answer Guide to Worksheet #2

BACKGROUND FOR **TEACHERS**

Note to the teacher: This activity leaves room for a variety of answers from students. The ones given here are for the teacher to use as a guide for assisting the class, should they need help.

1) Who owns the national parks?

   You do! The parks belong to everyone in the nation.

2) Where does the money for the parks come from?

   Money for parks comes from the federal budget (taxes paid by people in this country) and from entrance fees charged at some parks.

3) Can national parks be sold or developed for different uses?

   No. The parks were created to "conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." These words were written by Frederick Law Olmsted, Jr., a noted landscape architect of the late 19th century. His concept of conservation of scenery so that it is not diminished in value, quality, or condition into the future became a key component of the National Park Service Organic Act of 1916.

   In other words, lands and resources in the national parks may not be sold or developed specifically because they are to be preserved and protected for people now and in the future to enjoy.

4) Who takes care of the national parks?

   The National Park Service takes care of the day to day management and care of the parks. Park visitors — like all of us! — also have a responsibility to take care of the lands by cleaning up after ourselves, not littering, staying on trails, and abiding by park regulations.

5) A national park is created by an act of Congress. A national monument is created by Presidential Proclamation. Both types of land have outstanding or unique scenery or landmarks that are of national importance or interest.

6) What are some rules that you should remember when visiting a national park?

   ~ National parks belong to everyone.

   ~ Do not collect or disturb any rock, fossil, plant, or artifact.

   ~ Wildlife may not be hunted, trapped, or injured.

   ~ Do not feed any wild animal.

   ~ Pets must be leashed or otherwise physically restrained at all times. They are not permitted in public buildings, or with hikers on trails.

   ~ Firearms must be sealed, cased, broken down, or otherwise packed to prevent their use.

   ~ Camping and picnicking are allowed only in designated sites, or with a special permit.

   ~ All vehicles must stay on roads.

These Lands Are Your Lands:
Answer Guide to Worksheet #2

BACKGROUND FOR **TEACHERS**

7) Things that MAY happen in a national forest that may not happen in a national park are:

- ~ Cutting trees for firewood or timber sale.
- ~ Hunting or fishing with licenses at certain times of the year.
- ~ Rock collecting for personal use by individuals who have obtained a permit.
- ~ Mining for gold or silver.
- ~ Drilling for oil or gas.
- ~ Grazing of animals is generally be permitted in national forests.
- ~ Dogs may be taken on a trail or in the backcountry.

8) Two other land management agencies in the federal government are the United States Forest Service and the Bureau of Land Management. The Bureau of Indian Affairs and the United Sates Fish and Wildlife Service are two other agencies that students may know.

Questions 9 and 10 have more individualized answers.

Make Your Own Park:
Worksheet #3

ACTIVITIES FOR STUDENTS

Directions: In this exercise, you are going to invent a place that is so special that it is worthy of becoming a national park. Take your time, and answer the questions to help guide you through the process.

1) Think for a few moments about a place that you would like to visit, or have visited in the past. Use the space below to write down what it is, and make some notes for yourself about what makes it such a special place for you. You want to think about the features of the land that make your place interesting and significant to you. (Examples: waterfalls, hot springs, geysers, mountain meadows, canyons, rock forms, historic buildings, etc.)

_____

_____

_____

_____

_____

_____

_____

2) Now invent a place of your own that is just as memorable, and just as special, (if not more so!) than the first place you described. This site can be anywhere in the United States, and can look any way that you would like it to. It can contain anything natural or humanmade that you would like to see in it. When you have an idea of what your special place would look like, make some notes about its rare or unique qualities in the space below. This is in preparation for your planning to develop this site into a national park.

_____

_____

_____

_____

_____

_____

_____

Make Your Own Park:
Worksheet #3

ACTIVITIES FOR STUDENTS

Answer the questions below to help develop your land as a park.

1) What does your land have on it that makes it special? List three different things that make it unique or unusual.

   A) _____

   B) _____

   C) _____

2) Where is the land located in the United States? Who owns the land right now?
   (Note: National parks have usually been created on existing federal land. If your site is on private land, how could it be arranged with the owner to have it become federal land?)

   _____

   _____

3) Making an inventory of what is on the property is part of a landuse or park planner's job. List the physical features of your property. Include streams, lakes, rivers, springs, wetlands, cliffs, canyons, hills, forests, deserts, beaches, meadows, etc.

   _____

   _____

   _____

   _____

   You may want to make a small map of the site on the back of this sheet to help you locate all the resources on your land.

4) What are the special features of your land that are worthy of federal protection and preservation as a national park? For example, are there rocks, geology, caves, rivers, rare plants or animals, remarkable scenery, historic structures, or anything else that makes your property stand out?

   _____

   _____

   _____

   _____

Make Your Own Park:
Worksheet #3

ACTIVITIES FOR STUDENTS

5) What kind of work is needed to turn the land into a park? List below what needs to be done to make the land safe and accessible to people. Examples are: Does the land need to be fenced off? Are the boundaries clearly marked? What about signs to tell people where they are?

_____

_____

_____

_____

6) What kind of services will be necessary for visitors to come to the site? List four essential things that park visitors will need while they are at your site.

_____

_____

_____

_____

7) Where will roads, trails, bathrooms, Visitor Centers, picnic areas, campgrounds be located? On a separate piece of paper, draw a map of your site and locate these things on it.

8) How will you get money to pay for all of the things that need to be done to your site to make it accessible and safe for people to visit? (Keep in mind your site is to be of national significance and people from all over the country will want to come to see it.)

_____

_____

Can you guess how much how much money it will cost to develop your park?

_____

9) How many people do you think you will need to operate your park. List who they are and what they would do at your park.

_____

_____

_____

_____

_____

_____

These Lands Are Your Lands

BACKGROUND FOR **TEACHERS**

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Language Arts		**Standard 1** Reading Obj. 5.04 5.13 Writing Obj. 5.07 Reference Obj. 5.04 5.06 Thinking Obj. 3-5.18 **Standard 3** 5.05 5.06 5.12 **Standard 4** Reading Obj. 5.11 Listening Obj. 5.02 5.03 5.08 Thinking Obj. 3-5.01 3-5.04 3-5.15 3-5.17 **Standard 5** 5.01 5.23 5.06 5.07	**Standard 1** 6.20 6.22 6.25 6.32 6.37 **Standard 3** 6.01 6.06 6.07 **Standard 4** 6.04 6.09 6.27 6.34	**Standard 1** 7.15 7.19 7.22 7.26 **Standard 3** 7.01 7.06 7.08 **Standard 4** 7.12 7.24 7.26 7.28 7.35	**Standard 1** 8.11 8.14 8.17 8.32 8.33 8.34 **Standard 3** 8.01 8.02 8.06 **Standard 4** 8.20 8.23
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Science		**Standard 1** 1.03 1.04 1.05 1.06 1.07 1.08 **Standard 2** 2 .11 **Standard 5** 5.02 5.04	**Standard 1** 6.1.03 6.1.04 6.1.05 6.1.06 6.1.07 6.1.08 6.1.12 **Standard 2** 6.2.01 **Standard 5** 6.5.02	**Standard 1** 7.1.03 7.1.04 7.1.05 7.1.06 7.1.07 7.1.08 7.1.12 **Standard 2** 7.2.01 **Standard 3** 7.3.01	**Standard 1** 8.1.03 8.1.04 8.1.05 8.1.06 8.1.07 8.1.08 8.1.12 **Standard 2** 8.2.01 **Standard 3** 8.3.03

These Lands Are Your Lands

CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Science		**Standard 5** 5.04	**Standard 5** 5.03 5.04	**Standard 5** 7.5.02 7.5.03	**Standard 5** 8.5.02 8.5.03
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