Gateway

US Department of the Interior
National Park Service

Gateway National Recreation Area
Jamaica Bay Unit
New York

Plant Phenology: A Comparison of Two Trees

Gateway National Recreation Area
Jamaica Bay Unit

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Introduction

Dear Teacher:

Gateway National Recreation Area and the staff of the Jamaica Bay Unit are pleased to welcome you. The information in this packet is designed to acquaint you with the resources prior to your visit, so that you can make the most of your experience.

The National Park Service administers Gateway National Recreation Area. Our mission is to preserve and protect the natural and cultural resources in the park. Education plays a vital role in the accomplishment of this objective. The foundation of this program is built on the New York City standards and emphasizes hands-on investigation of natural resources.

Our approach to environmental education is interdisciplinary and hands-on. The success of the program depends on the incorporation of both the pre-site and post site activities, included in this packet. It is extremely important that your students bring the field experience back to the classroom and the home/school environment.

The Jamaica Bay habitat areas offer the opportunity for exciting investigations of the physical and natural worlds. Our primary goal is to stimulate children's natural sense of wonder and educate them about their environment.

What is the National Park Service?

The National Park Service is a bureau of the U.S. Department of the Interior. The "Organic Act" of 1916 established the National Park Service"...to conserve the scenery and the natural objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations...". The mission of the National Park Service is to protect and maintain these cultural and natural resources for the use and enjoyment of all people today and in the future.

Today, there are over 401 sites in the National Park System. These sites include national parks, historic sites, recreation areas, preserves, seashores, scenic rivers, lakeshores and scenic trails. The System is divided into 7 regions. Gateway NRA is part of the Northeast Region, which consists of some 100 units and related areas. Other parks in this region include Statue of Liberty/Ellis Island National Monument, Acadia National Park, Edison National Historic Site, Cape Cod National Seashore and Gettysburg National Military Park. For further information on parks in this region, contact your nearest national park, or visit us on the Web at www.nps.gov.

Active participation in *your* parks is encouraged. The Volunteers in Parks (VIP) program offers those interested, the opportunity to give their time and abilities to support park programs and resource protection. For further information about volunteering, contact any Gateway unit.

PLANT DIVERSITY

Target Audience: 2nd–3rd grade

Length of program: 90 minutes – 2 hours

Theme:

Plants have many features which allow them to grow, reproduce and carry out life functions such as respiration and movement based on the availability of resources in their environment. These features are called adaptations. Plants respond to changes in the environment including seasonal changes such as budburst, leaf out, seed development and leaf fall. Gateway National Recreation Area includes a variety of habitats and is home to various wildflowers, shrubs, evergreen and deciduous trees which respond differently to seasonal changes. Scientists monitor these changes in order to learn about climate change and its impact on species interactions.

Goals:

1. Students will be able to understand that plants and trees undergo physical changes in response to seasonal changes.
2. Students will be able to identify various phenophases (stages in the life cycle) in deciduous and evergreen trees.
3. Students will understand the difference between deciduous and evergreen trees, and how plants utilize adaptations to cope with seasonal changes depending on the availability of resources.
4. Students will learn how to use observation and nature journals to record seasonal changes in trees.

Objectives:

- Students will observe (in the park or at school) the appearance of deciduous and evergreen trees throughout the year in response to seasonal changes.

- Students will identify the different observed phenophases (leaves, flowers, fruit, seeds) of deciduous and coniferous trees, and note what phases are absent.

- Students will observe how saplings develop and how they resemble their parent trees.
- Students will compare deciduous and evergreen trees to see how their respective parts have similar functions but different adaptations for dealing with environmental changes.

- Students will sketch and record observations in a nature journal and make predictions based on their observations.

CURRICULUM CONNECTIONS

New York City Department of Education
Elementary School Scope and Sequence for Science

Content Standards:
NYS Elementary Science Core Curriculum K-4
Standard 1- Analysis, Inquiry & Design

- Key Idea 1 -Scientific Inquiry

Standard 2- Information Systems

- Key Idea 1- technology is used to retrieve, process and communicate information

Standard 3 –System's Thinking

- Key Idea 1-Recognize commonalities

Standard 4 - Science

- Key Idea 1- Patterns of daily, monthly and seasonal changes
- Key Idea 1 – Living Environment
    - Characteristics of and variations between living and non- living things
    - Life process common to all living things
- Key Idea 2- observe and describe how plants grow and change in predictable ways
- Key Idea 3- organisms and species change over time
    - Each plant has different structures that serve different functions
    - In order to survive plants and animals adapt
- Key Idea 4 – Continuity of Life is sustained through reproduction and development
- Key Idea 5 – Basic life functions of common living specimens
    - Survival behaviors of common living specimens

Key Idea 6- Plants and animals depend on each other and their physical environment

NYS learning standards **STEM** – Standard 4- Science – students will understand and apply scientific concepts, principles and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Intermediate Level Science Core Curriculum- Grades 5-8

Standard 1- Analysis, Inquiry & Design

- Key Idea1: Scientific inquiry
    - 1.1 Formulate questions independently with the aid of references appropriate for guiding the search for explanations of everyday observations
        - 1.1a formulate questions about natural phenomena
        - 1.1b identify appropriate references to investigate a question
    - 1.2 Construct explanations independently for natural phenomena by proposing preliminary visual models of phenomena
        - 1.2a formulate a hypothesis
        - 1.2b propose a model of natural phenomenon

Standard 2 – Information systems

- Key Idea 1: Technology is used to retrieve, process, and communicate information
    - 1.1 Use a range of equipment and software to integrate several forms of information in order to create good- quality audio, video, graphic, and text based presentation

2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow

LS2.A Interdependent Relationships in Ecosystems

Plants depend on water and light to grow. (2-LS2-1)

Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)

ETS1.B: Developing Possible Solutions

Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

TRIP INFORMATION

Travel Directions

Refer to the map of Gateway National Recreation Area.

From Manhattan, Brooklyn and Queens: Take the Belt Parkway to Exit 11S, Flatbush Avenue South. Proceed south on Flatbush Avenue approximately one mile to the traffic light before the bridge. Turn left at the light onto Floyd Bennett Field. Stay on the main road and make the second left and follow the signs for Ecology Village / Building 70.

From Rockaway: Take Beach Channel Drive to Marine Park Bridge. Cross the bridge and make a right at the first traffic light onto Floyd Bennett Field. Stay on the main road and make the second left, follow the signs on that road to Ecology Village/ Building 70.

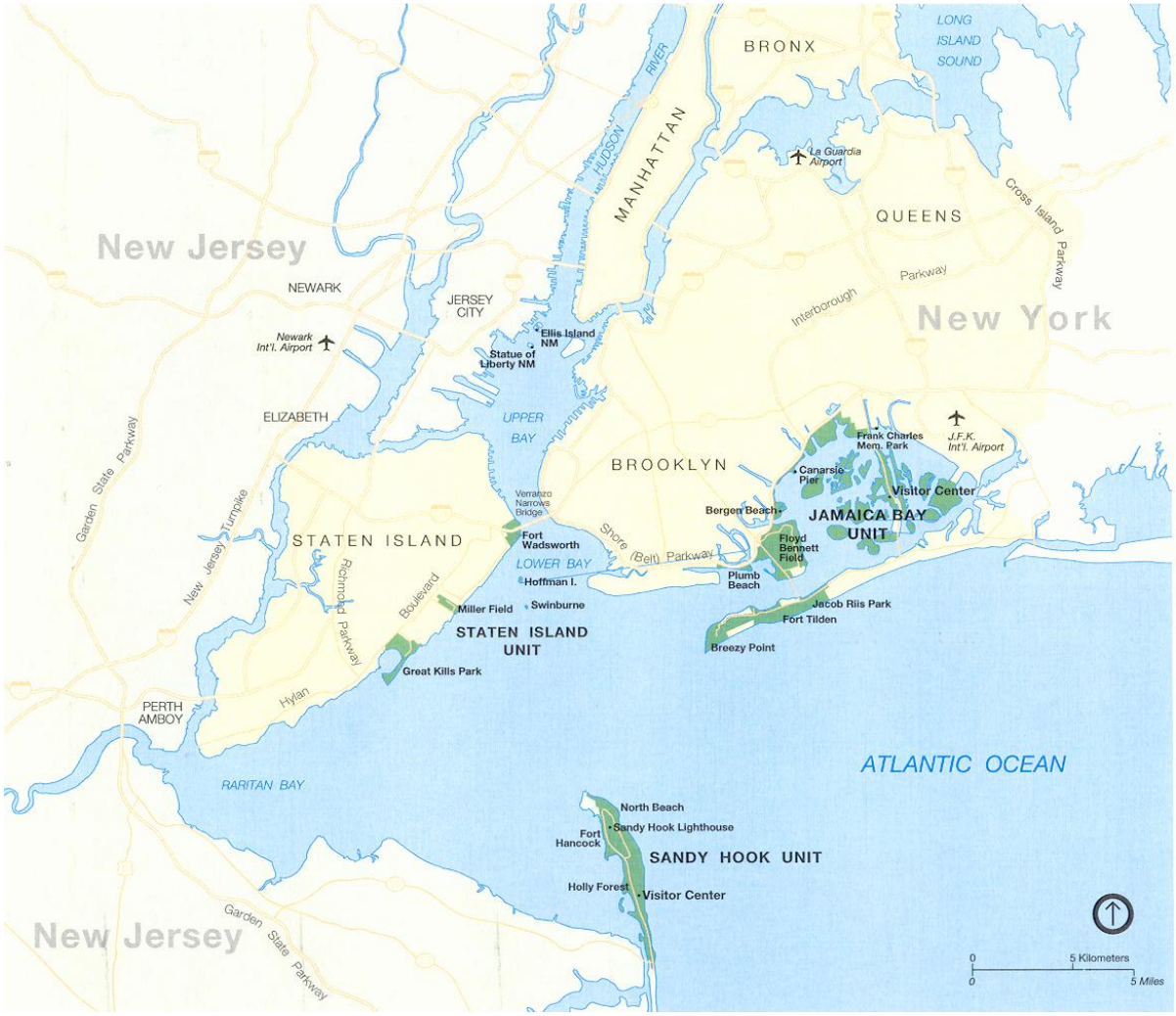
Bus Permit for the Belt Parkway

A bus permit is required by all buses traveling the Belt Parkway. The issuance of a permit is subject to restrictions, due to construction schedules. If you intend to use the Belt Parkway, inquire about a permit with the bus company.

Program Information

When you arrive at the Floyd Bennett Field, proceed to "Ecology Village"; turn into Floyd Bennett Field and take the second left. Park staff will meet you and begin your program. Groups are expected to arrive at 10am unless otherwise noted. Please call (718)338-4306, or 718-338-3338 ext. 274 if you are going to be late or have to cancel your visit for any reason. Ranger guided programs last from 10am to 12pm. Afterwards, most classes spend approximately ½ hour for lunch and bus boarding.

Gateway National Recreation Area



THINGS TO REMEMBER

Preparation

1. The success of your visit depends on how well you and your class are prepared. Please review the teacher packet and provide necessary information about the site and class visit to your students. Discuss the park rules with your class and chaperones before the trip. Failure to follow the rules and improper behavior could lead to early termination of the class visit.

2. Please have at least one adult chaperone for every ten children. At no time are students to be left without adult supervision. Chaperones are encouraged to take part in Ranger led activities.

3. Students are free to explore under the guidance of the Ranger. The teacher and chaperones are responsible for discipline and control of the class. The class must stay together as a group and stay on the trails unless otherwise directed by the Ranger.

4. To make the trip more personal for each student and to facilitate communication with Ranger staff, we recommend that the students wear name tags.

5. The Phenology - Plant Diversity program requires that students come prepared for the on-site activities by having prior experience working in their cooperative teams and have an understanding of various environmental concepts. This can be assured if you work through the recommended pre-visit assignments with your students.

Dress

1. Floyd Bennett Field is usually windy and cool because it is near the shore, so please dress accordingly. We suggest the students wear layered clothing: a hat, scarf, gloves and long johns in cool weather, a hat and sun protection in warm weather. Rain gear such as a tarp or raincoat and rain boots should be brought along, as the students will be expected to go outdoors, rain or shine.

2. Students should wear casual clothing as they may be required to sit on the ground or walk through muddy areas. All students should wear long pants and a long sleeved shirt (regardless of the temperature) and closed, comfortable walking shoes, boots or sneakers. Open sandals and high heels are **not** recommended.

Safety

1. Ticks are commonly found on and near vegetation during the spring, summer and autumn. They can be avoided by staying on the trails and dressing properly. For further information, please read the tick information bulletin included in this packet.

2. Poison Ivy is ubiquitous throughout the park. It is identified by its smooth-margined leaflets in groups of three, aerial rootlets and creamy white berries. It can grow as a vine, woody shrub or ground cover. Students can avoid contact with poison ivy by staying on the trails and not touching plants they are unfamiliar with. If contact does occur with this plant, wash well with soap and water.

Lunch

1. There is no food concession at the Floyd Bennett Field and an indoor eating space is not available. At the discretion of the teacher, students can bring a bag lunch for or after the program.

2. A gazebo is located outside of the Building 70 at Floyd Bennett Field. Please collect all of the lunches and place them in a large box or bag for distribution after the program. In the event of inclement weather, lunches could be brought back to the school, or with the permission of the driver, eaten on the bus.

Things to Bring

1. First aid kit, insect repellent and drinking water (other beverages are not permitted on the trail).

2. Extra lunches, clothing, rain gear, watches or timers, and pencils for those students not prepared.

    a. Binoculars, hand lenses, field guides and a small notebook are recommended. Please note: specimen (i.e., soil, water, plants, shells, etc.) collecting is not permitted even for educational purposes.

HISTORY

Jamaica Bay's form has been determined largely by the glaciers that intermittently covered our region between 1.5 million and ten thousand years ago, and the melt waters and outwash that formed much of southern Queens and Brooklyn. Wind, wave, tide and creeks have been and continue to be dynamic forces sculpting the ever-changing borders and the shape of Jamaica Bay.

The retreat of the glaciers coincides with the oldest dated remains of Native Americans in this area. The Lenape Indians dwelled around Jamaica Bay where they hunted, fished and collected wild grains and fruits. Starting approximately 1,000 B.C. they began cultivating maize, beans and squash.

Dutch settlers arrived in New Amsterdam in the 1600s. They traded with the Lenape and learned much about hunting, fishing and farming form them. The Dutch and other European settlers eventually gained dominance over the land.

Floyd Bennett Field, named for the famed pilot Floyd Bennett, was the first municipal airport in New York City. It opened in 1931 to the public. Famous pilots such as Wiley Post, Charles Limburg, Howard Hughes, and Emilia Earhart flew through here. In 1941, the U.S Navy took over the field to fight for World War II. The field remains a historic site today.

The nineteenth century witnessed a period of rapid growth in New York City as population and industry expanded. In order to accommodate this development, much of the marshland in and around Jamaica Bay was drained and filled through the 1950's. The bottom of the bay was dredged for fill, or to create channels for water-borne transportation.

Robert Moses, Commissioner of Parks for New York City, realized the great loss of resources that accompanied the destruction of the bay and sought a plan to arrest the dangerous trend. In 1950, the city adopted his proposal to develop five parks around the bay and the Jamaica Bay Wildlife Refuge was established. Shortly thereafter, plans were put in motion to improve the area and create additional habitat for a diverse wildlife population.

In 1953, the New York City Transit Authority sought permission from Commissioner Moses to build an embankment for the IND train track across Jamaica Bay. Mr. Moses granted the permit with the stipulation that the Transit Authority construct a series of dikes or impoundments that would prevent the flow of tidal waters behind them. Rain water filled these natural low lying areas, the results of which became the 45 acre West Pond and the 120 acre East Pond.

Material was dredged from the bay to create additional upland landmasses. These areas, as well as the early dikes, were then planted with vegetation that would stabilize the new soils, as well as provide important food, cover and nesting areas for wildlife.

Much of the early work was accomplished by a small crew of workers headed by Herbert Johnson, the first manager of the Jamaica Bay Wildlife Refuge. He spearheaded the plans for habitat improvement, developed an environmental education program for urban school children and created a trail system for the enjoyment of the visiting public.
On October 27, 1972, the United States Congress authorized the National Park Service to accept donations of land from New York and New Jersey to establish Gateway National Recreation Area. One of these acquisitions included the Jamaica Bay Wildlife Refuge. Today the refuge's 9,155 acres of salt marsh, open bay, freshwater ponds and uplands provide safe haven for marine life, small mammals, reptiles, amphibians and over 325 species of birds.

NATURAL RESOURCES

THE UPLANDS

Definition: Higher ground not subject to marine tides or standing water, often characterized by the presence of woody plant species and other vegetation.

Ecological Importance: The fruits, buds, leaves and stems of upland plants provide food for a wide variety of insects, birds and mammals. Thick vegetation offers cover from predators as well as nesting sites and shelter for all forms of wildlife. The deciduous nature of many woody plants leads to the annual input of organic matter into the soil each autumn, in the form of detritus. This detritus is fed upon and broken down by fungi and soil organisms and, through time builds a topsoil of moist, nutrient rich humus. Through the years, uplands go through the process of natural succession as pioneer plants that require strong sunlight and do well in poor soils get replaced by more competitive, shade-tolerant species that thrive in moist, rich environments. Through evaporation and transpiration, woodland communities supply significant amounts of moisture to the atmosphere and moderate the local climate. As a by-product of photosynthesis, the oxygen given off by green plants is important to most animal life on earth.

Upland Plants: Here at the Floyd Bennett Field, the upland plants include species that were planted to provide food and cover for wildlife as well as naturally occurring early successional species. Original tree plantings of autumn olive, Japanese black pine, European alder, willow oak, red maple, red cedar, American holly and cottonwood still persist. Some of these, particularly species native to the area like American holly and red cedar, are successfully reproducing and saplings can be found throughout the upland community. Gray birch, black cherry and pussy willow, native early successional woodland species, have appeared here on their own, without the help of humans. In addition to trees, a variety of woody shrubs and vines can be found in the uplands including poison ivy, bayberry, European buckthorn, winged sumac, multi-flora rose, Virginia creeper, Japanese honeysuckle and oriental bittersweet. Wildflowers, ferns and grasses are also common.

Upland Animals: During spring, the uplands brim with activity as migrant warblers, vireos and tanagers touch down to glean insects from the tree limbs before continuing their northbound journeys, and resident songbirds begin their breeding and nesting season. Squirrels make their leafy nests high in the trees and chipmunks can occasionally be seen scurrying across the trail as they forage for food. Box turtles, snakes, even tree frogs, though well hidden, are common upland residents, as are earthworms and other soil invertebrates, and a host of insects from beetles to fireflies. Songbirds such as mockingbirds, mourning doves and robins feed of the fleshy fruits of many upland plants. Finches, sparrows and nuthatches prefer the dry fruits and seeds of birch, alder, pine and

many herbaceous plants. During the autumn migration, woodland hawks hunt small birds and mammals in the uplands. In winter, the evergreen pines and cedars offer important cover for many wildlife species and superb roosting areas for owls.

The Barrier Island

Definition: Jamaica Bay is surrounded by uplands around the bay, as well as much of the Rockaway barrier beach. Barrier Island is a narrow stretch of land that was developed parallel to the mainland. The ocean is on one side with the bay on the other. Most of the beaches, wetlands, marshes and estuaries in the Jamaica Bay unit are protected, which mean that they are not open to the ocean but protected by the Barrier Island.

Ecological Importance: Barrier islands play an important role in mitigating ocean swells and other storm events for the water systems behind on the mainland side of the barrier island. This creates a unique environment of relatively low energy, brackish water. Multiple wetland systems such as lagoons, estuaries, and/or marshes can result from such conditions depending on the surroundings. Without barrier islands, the wetlands and marshes in Jamaica Bay would not exist and would be destroyed by daily ocean waves and tides as well as ocean storm events.

Barrier Island Animals: Beaches on the Breezy Point peninsula, located on Rockaway Barrier Island, are home to one of the most diverse breeding shorebird areas in the Metropolitan area. Shorebirds that breed here include the Piping Plover, Common Tern, Least Tern, Black Skimmer, and American Oystercatcher. Other animals that can be found on barrier animals are horseshoe crabs, Atlantic ghost crabs, Dragonflies, and Monarch Butterflies. Some plants that can be found are Sea beach Amaranth, Bayberry, Goldenrod etc.

PRE-VISIT ACTIVITIES:

- Review parts of plants/trees and their functions.
- Review seasons and their respective characteristics.
- Review what plants need to grow and reproduce.
- Learn to make scientific observations and science vocabulary.
- Learn the difference between deciduous and evergreen trees.

Vocabulary List:

Students should be familiar with the following terms before the onsite visit:

Season	Tree Parts	Phenophase	Life cycle	Monitor
Winter	Leaf	Buds	Reproduction	Resources
Spring	Root	Flowers	Metabolism	Hypothesis
Fall	Trunk	Fruits	Movement	Data
Summer	Seeds	Leaves	Respiration	Predict
	Stem	Leaf fall	Photosynthesis	

ON-SITE ACTIVITIES:

- Give park orientation to students
- Give phenology PowerPoint to students
- Hand out junior phenologist notebook and clipboards to students
- Ranger will lead nature hike
- Students will observe and record data in their notebooks
- Students will work in groups to do the color matching activity with the natural environment using the color grids
- Take students back to Building 70 and play nature "Bingo"

POST VISIT ACTIVITIES:

- Find trees to monitor at school, home, etc.
- Join Project Budburst (Budburst Buddies)
- Visit park 3 more times to make and record observations

- Identify phenophases of target species
- Identify phenophases of a different deciduous and evergreen trees
- Make a Venn diagram to compare/contrast Black Cherry with Red Cedar
- Match deciduous parts with evergreen parts
- Make a "Tree Journal"
- Monitor the observed trees online

Plant Phenology lesson plans

PRE-VISIT ACTIVITY

Prior to visiting the park to engage in phenology monitoring, the students should know the following:

- The names and sequence of the four seasons and how each differs from the others.
- The different parts of plants and trees and their functions.
- What do plants need to grow?
- The differences between deciduous trees and evergreen trees.
- Adaptations of deciduous trees and evergreen trees.

The following are activities that can be used in addition to your regular classroom curriculum to prepare students for their field trip.

Seasons:

Have the students make a class collage of each season using magazine or newspaper pictures and drawings. As each season is finished, talk about why they chose the pictures they did, and how each season is different from the others. Include in the discussions temperature, hours of daylight and precipitation.

Plant parts and their functions:

Have students work with partners to draw a tree. Include and label roots, leaves, flowers, fruits. Have them also remember the function of each part and share with the group their ideas.

Needs of plants:

1. Ask students to remember what plants need to grow (air (CO_2), sun, water, soil with nutrients). On a piece of chart paper divided into fourths with a tree drawn in the middle, label each quadrant as they give you the correct answer. Ask them what would happen if one of these resources

was limited or missing? How would they know? How could they test their ideas?

2. Tell them that two resources that plants need that change through the seasons are the amount of sun and water a plant receives. Refer to their season collages and ask them if they can figure out how these two resources change through the seasons.
3. Conduct the following experiment utilizing the scientific method:
   Question: How does the amount of sunlight affect a plant's growth?

   Hypothesis: (Have students come up with a hypothesis about more sun/less sun. The teacher can decide how many hours for each condition. Hypothesis should be stated as "If…….., then…….".
   Materials: Three potted plants, same species/size; two paper bags or boxes to block sun

Procedure (method):

1. Label each one with a nickname (Plant A, Plant B, Plant 1, people names, whatever you/the class chooses to differentiate the plants).

2. Place one plant outside in a sunny spot all day/night (make sure plant can tolerate full sun), another plant gets put out with the first plant in the morning but gets put back in the classroom at the end of the school day, and the third plant stays in the classroom inside of a paper bag/box all day and all night. If possible, begin investigation on Monday and end Friday, making sure that all plants start out with the same amount of water. You can take a "before" picture or have the students sketch each plant in a science journal so they can make a comparison at the end of the experiment. You can also measure each plant, count the number of leaves/flowers, etc., and note it on a piece of chart paper or in a science journal.

3. On Friday afternoon, bring the three plants together again. Measure, count, note color, structure, etc.

Results:

Make graphs comparing before and after data. Have students work with a partner to interpret the graphs. Have them come up with questions they could ask that can be answered using the graphs.

Conclusion:

Ask the students if their hypotheses were supported by the results (data), why or why not? Have them share with a partner their answers, then engage class in a discussion about the connection between the number of

hours of daylight and plant growth/reproduction. Ask them to think about which seasons have more daylight and which have less. How would plants respond to these seasonal changes based on their experiment and its results? In what season would you expect to see new growth?

*This activity could be recorded individually in order for the students to practice the scientific method. It also doesn't account for temperature difference inside/outside, so if there was a safe way to maintain all three conditions (variables) outside the whole time it would be better (place second plant in box/bag for part of day). The use of the term "variable" could also be included.

Plant Adaptations: Deciduous vs. Evergreen

- In this activity students will learn that trees have different adaptations for coping with the changes in daylight, temperature and available water.

1. Teach the simple meanings of the words, "deciduous" (leaves fall off in autumn as temperatures cool and the days "grow shorter"), "evergreen" (trees retain their leaves year round). Show pictures of both types of trees in autumn and have students identify them. Then have them look closely at the leaves and note the differences: evergreen trees have thin, needle-like leaves or very tough, waxy leaves, while deciduous trees tend to have more flexible, broader, flat leaves. Show more pictures of both types of trees in different seasons, and see if they can sort the evergreen and deciduous trees accurately.

2. Have students focus on leaf shape. On a piece of chart paper, draw and label a deciduous leaf (broad, flat) and an evergreen leaf (narrow like pine or small and scaly like juniper or cedar or tough and waxy like holly). Have them remember the function of the leaf (produce food/photosynthesis). Point out that both leaves perform the same function.

3. Show pictures of a deciduous tree during the four seasons. Ask students to share what they observe about how the leaves change: turn color (lose green pigment so they can no longer produce food), leaves fall, then new leaves grow and the tree starts producing food again.

4. Show pictures of an evergreen during the four seasons. How do the leaves change? (They don't change as obviously. Dead needles can be present all year; new growth in the spring is a lighter color than older needles. The trees retain leaves all year.)

5. Ask students to think about why trees would not make food during fall/winter. (Have them think about what plants need to make food: sunlight, water, air and soil). Are all resources abundant during the winter?

Discuss how the resources are limited (sun because of the position of the Earth and in areas with snow it is not available to the roots until it melts in the spring). Point out that plants save energy by not "working hard" during times when they can't make food. That's why deciduous trees lose their leaves: they store energy while they wait for more sun and water. Evergreen trees have other adaptations that allow them to retain their leaves and not waste energy (their shape allows them to retain some moisture and keeps them from being "pulled" off the tree by wind or snow), allowing a minimal amount of photosynthesis to occur.

6. Guide students in completing a Venn diagram with Deciduous and Evergreen trees. (Both have leaves, trunks, flowers, seeds, need air, etc.; Evergreen retain their leaves, have thin, needle like leaves or thick, waxy leaves; Deciduous have leaves that change color in autumn and fall off of the tree. New leaves begin to bud in the spring).

Science in the park/Phenology (teacher/park) Day of Visit

Jr. Phenologist nametags

Review Seasons: (5 minutes)

1. Show pictures of the park during the four seasons. Have students identify the seasons and explain their choices.

Review Needs of Plants/Functions of Parts of Plants: (10 minutes)

2. Have students name the different parts of a plant/tree.

3. Pass out the function cards to 6 students and have them work with partners around them to decide which function goes with which part. Ask each group to decide which part of the tree their card represents, based on the function of the part.

Plant Adaptations (15 minutes)

4. First, help students understand what an adaptation is: something an organism has (physical) or does (behavioral) that allows is to be successful in its environment.

5. Help students recognize some adaptations humans have: hair/fur for warmth and to protect from the sun; walk on two legs which allows us more

access to resources; when we get overheated we sweat to cool down. Ask them to think of other adaptations humans or other animals have.

6. Plants also have adaptations that allow them to thrive in their habitats. Show a picture of a prickly pear cactus and ask them to tell you what they know about it (it lives in areas where there is little water, collects and stores water in leaves, has spines to keep animals from eating it). Point out that one way it copes with heat and little water is that the leaf is light green, so it reflects the sun which keeps the plant cooler. It also has thick, waxy leaves that help hold the water in the leaf so the cactus can grow and reproduce, even when there isn't a lot of water but there is the right amount of sunlight.

7. Have students work in groups of two or three, and pass out plant cards. Have them work together to figure out some adaptations that help their plants survive in their habitats. Remind them to think about water, temperature and sunlight.

8. After a few minutes, have each group choose someone to share their ideas, explaining their thoughts.

9. Show a picture of a Black Cherry tree and a Eastern Red Cedar. Tell them that while they have the same plant parts with the same functions, their parts look different as they have developed different strategies for survival in their environments. One of them is "deciduous" and the other is "evergreen". Give them a couple of minutes to work with a partner to decide which is which, and to also explain the two terms. After a few minutes, hold up both pictures and have them point to the deciduous tree. Ask for a volunteer to define "deciduous". Then ask another student what type of tree the other one is (evergreen). Choose another student to define that. Tell them these are two different trees we will study today in order to help scientists learn more about how they change with the seasons.

"Scientific Data Collection" (60 minutes)

10. Tell the students that now they are going to put on their scientist hats and become Jr. Phenologists. Tell them that phenologists study how living organisms respond to changes in the seasons. Explain that they will help other scientists learn how trees in Gateway change with the seasons by looking for different phenophases (life cycles) on the targeted trees. Scientists think that the timing of the phases may be changing, and the students will help them learn if this is true by looking at the trees and writing what they see.

11. Reintroduce the deciduous tree, Black Cherry. Tell them they will look for several different phases of the life cycle, or phenophases. Share information about the tree and its phenophases using the laminated pictures (see cards

and data sheets for specific phases). Point out that while the phases are sequential, more than one phase can be present on a tree.

12. Next, reintroduce the evergreen, Eastern Red Cedar. Explain that this isn't really a cedar, but is part of the juniper family. Using the pictures as before, talk about the tree and its six phenophases.

13. ***Black Cherry Tree flowers contain both male and female parts, whereas Eastern Red Cedar trees contain all male or all female flowers. This can be included in lesson if the teacher desires. The information isn't necessary for monitoring, but is interesting in terms of plant parts and reproduction, and the second grade standard of comparing plants. Pictures are provided and you can look for both in the field.

14. Based on the current season, the different functions of the different parts of the trees and what trees need, ask students to predict what phenophases they think they will see. Have them state their hypotheses by holding up each card, asking if they think they will see that phase, and why/why not. Encourage them to put it in an "If……, then……." statement: " If it is spring, then we should observe new leaves"; "If it is spring, then we should not see colorful leaves," etc. No feedback is necessary from instructor.

15. Pass out Jr. Phenologist booklets and pencils. Help students write the date and time (it would be helpful to have a whiteboard or chart paper to write info that students can copy).

16. Note the weather (sunny, windy, cloudy, etc.) Explain that all nature observations should include this information so scientists can better understand the results of these studies. Also write date and time. Tell the students that they will work in small groups to observe a Black Cherry Tree and an Eastern Red Cedar, and they will mark in their booklets the phenophases they observe.

17. Begin walk around chosen path. Ask students to watch for the types of trees you will be observing. Also have them look for birds, insects and other wildlife while they walk.

18. When you arrive at the flagged trees, see if students can point them out. Discuss what phenophases they see right away.

19. Then have them stand quietly for one minute to listen to the sounds around them while quietly observing the trees, ground and sky. After a minute have them share what they heard or saw and note/sketch the results in the appropriate area in their booklets.

20. Divide them into groups with an adult in each group so they can more closely examine their trees. Assign each group a different flagged tree (if possible the trees should be spread out enough to give each group room to work, but close enough to allow the groups to be able to observe the others after their initial observations), having all students observing the same type at the same time. Have the adult help his/her group fill out the appropriate "nickname" (as indicated on marker for monitoring) of their tree and check off in their booklets the phenophases they observe (see Instructions for Small Group Leaders). Also make sure each adult has a clipboard with the small group instructions and two National Phenology Network Data Collection Sheets (one for each species) on which they record the group's findings.

21. After recording their observations each group will get a few minutes to sketch a small portion of their tree. Have the students make a triangle with their index fingers and thumbs. Hold it as close to the part of the tree they want to sketch, and only sketch the part that is inside the triangle.

22. After sketching, have them discuss their initial observations in their groups, then have the whole group move to the other trees they will be observing. Follow the same steps as in #14 above.

23. After observing both types of trees, and studying both sets of phenophases, have the students discuss what was similar and what was different.

24. While still at the observation site, have the students look for saplings on the ground under the trees they have been observing. Ask them to match the saplings with the adult trees. How did they know? Point to fallen fruits and cones to help them make the connection between the part of the plant and its purpose. Ask them what time of year they think the seeds begin to sprout. Why?

25. It's time to return to the campground for processing and closure. While you walk back to the campground as a group, stop at other trees along the way (all different species) and ask students to determine if they are evergreens or deciduous. How do they know? What phenophases do they see?

26. Back at the campground review the phases that were observed. Ask if the results of their observations support their hypotheses about the phases they thought they would see.

27. Ask if the phases match the season, then have them decide what phases were not present. Have them state what phases should follow what they observed. What conclusions about seasons and phenophases can they make

based on the results of their observations? How will recording this information over time help scientists learn if the timing of the phenophases is changing?

28. Refer back to the saplings and the fallen fruit/cones. Ask them what other observations they have about the parts of the trees that serve the same functions (bark, leaves, flowers, fruits, seeds). Did any of them look similar? Describe the differences. Ask them to share with a partner how each tree could be healthy and fit in the same environment even though their parts looked different. (This is very open ended. You can ask them to again think about what trees need and how they get those resources. Have them think about the design of the parts. Can those parts still access resources and/or perform their functions?) Have students share their ideas.

29. Ask them to also share what insects, birds or other animals they saw in the different trees. Do they think they would see the same animals in the following season? Why or why not?

30. Collect the clipboards and tell the students that the park is going to enter their data into a database that scientists use to monitor the trees as they change through the seasons. The students can also go to a website at the National Phenology Network to follow the phenophases of their trees as other schools and individuals enter observations.

31. Tell the students that they are welcome to come back to Ecology Village with their class any time to check on their trees, and that the same trees can be found in other parts of the park and the city. They can also visit other public areas of the park with their families to observe the same kinds of trees through the seasons.

32. Show them Budburst Buddies and how they can choose their own tree to monitor at home, school or even the park! Tell them their teacher has booklets for them. Point out that half the class could choose deciduous trees or shrubs, and the other half could choose evergreens, and they could compare their observations during the rest of the school year.

33. Students should write their names and the date on the certificates in their booklets, and the ranger should sign them and answer any other questions the students might have. Congratulate our Jr. Phenologists on a job well done!

Instructions for Small Group Leaders

Materials: Clipboard with Data Sheet from NPN, extra pencils

Instructions:

- Help your group write the nickname of their tree in their Jr. Phenologist Booklets. The leader should also write the nickname on the NPN data sheet as well as the date.

- Ask students to look at the pictures in their booklets. As a group, go through the pictures and put a checkmark by the phases that you can observe. Have the students decide whether or not the phase is present, and make sure they all mark their booklets according to what the group decides. If they are making inaccurate observations, the leader should ask questions; point out specific parts of the tree, etc., to help them accurately identify the phenophase.

- As the students decide on each phase, the Small Group Leader will record the information on the NPN data sheet on the clipboard.

- After all of the phases have been recorded, the leader will ask the students to comment/discuss what they have discovered. Then the leader will ask them to make a triangle with their index fingers and thumbs, and look at the tree through that triangle. Students should then draw the area of the tree that they see through the triangle. The purpose of this activity is to have them focus on a small part and look for detail. It doesn't have to be exact, and whatever they draw is acceptable. The leader should also let them know that they only have a couple of minutes to sketch, and this is quiet time.

- All of the groups should be about finished at the same time. After recording and sketching, you will lead your group in a rotation to look at the other flagged trees. No observations or sketches are made, but you will help the students observe similarities and differences between the tree they observed officially and the other trees of the same species.

- After each group has had a chance to look at all the trees, the Instructor will collect the extra pencils, clipboard and observation sheet.

Post Visit Activities

There are several options for follow up monitoring.

1. Ideally the class would visit the park during the other seasons to observe the same trees. In this case, the students could begin their Budburst Buddies field guides at the park using the trees they observed, and continue observing the same trees in subsequent visits. (Please visit Project Budburst at http://neoninc.org/budburst/).

2. Tree/trees or shrub/shrubs on campus that the children can visit on a regular basis could become the target species for at least four observations, preferably during different times of the year. Project Budburst issues certificates to children who provide (input) data for four observations of the same tree/shrub. Provide each child with a Budburst Buddies field guide and take students outside to begin observing. Each student (or small groups of students) could "share a tree" or shrub, everyone could observe the same tree/shrub, or each student could have his/her own tree/shrub to monitor.

3. Take a "nature" walk through campus or the neighborhood and identify the deciduous and evergreen trees and their observable phenophases.

4. Visit the Brooklyn Botanic Gardens and find your target species. Compare with Gateway observation. Look for evergreen and deciduous trees. Identify phenophases.

5. Have students choose one of the trees they observed at Gateway and illustrate/journal about a year in the life of that tree.

6. Write/illustrate a conversation between a Black Cherry tree and an Eastern Red Cedar. Include discussion points about weather, seasons, similarities and differences.

7. Have students work with partners to match pictures of the phenophases of the Black Cherry with pictures of the corresponding phenophases of the Eastern Red Cedar.

8. Log onto (NPN) and track the trees you observed at Gateway.

9. Share your ideas with us!!!

For an easy definition of phenology visit Project Budburst at
http://neoninc.org/budburst/phenology_defined.php
To download Budburst Buddies Journal Pages:
http://neoninc.org/budburst/buddies/journal_pages.php

References

- Environmental Literacy Framework:
  www.andrill.org/education/elf

- USA National Phenology Network (Nature's Notebook):
  www.usanpn.org

- Project Budburst:
  neoninc.org/budburst/

- Great Pollinator Project of NYC:
  greatpollinatorproject.org

- Brooklyn Botanic Garden:
  www.bbg.org/

- National Park Service:
  www.nps.gov/gate