Making Deltas Out of Mountains

Background Information for Teachers

Deltas begin with the water cycle – as rain falls over mountains, erosion begins. The energy of the flowing water is transferred to the rock cycle, so the rock is worn down into smaller and smaller pieces and is mixed with the flowing water. Most of that material (sediment) is deposited at the mouth of the river, usually where the river meets the sea. The deposit is called a delta.

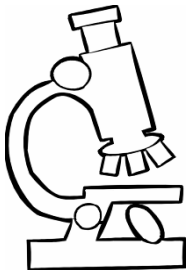
Deltas are created worldwide, as rivers flow into seas, lakes, deserts, etc. What kind of delta is formed depends on factors such as the nature of material from the mountains and land, the incline of land into the sea, and the strength and duration of tidal surges.

Here in south Louisiana, the Mississippi River forms a giant bird's-foot delta. The Mississippi-Missouri river system collects eroded debris from the entire central half of the United States. Upon reaching the Gulf of Mexico, the river's speed (velocity) slows, abruptly reducing its capacity to carry suspended mud and sand (sediment). That sediment is deposited in vast alluvial fans, and these these underwater (submarine) fans are major sources of petroleum, natural gas, and sulfur for the entire United States.

The process that starts with the water cycle continues into the rock cycle (weathering and erosion) and forms the delta with deposition when it arrives at the sea. As the sediment is layered upon itself, over time it compacts into sedimentary rock, which is pushed farther into the earth and with heat and pressure is changed (metamorphosed) into metamorphic rock. This rock is then re-exposed to the surface of the planet through volcanic action or up-lift (tectonic plates). Once it is exposed the rock cycle begins anew, with chemical and mechanical weathering, and erosion.

Image Credit: University Corporation for Atmospheric Research The Regents of the University of Michigan http://www.windows.ucar.edu/tour/link=/earth/geology/rock_cycle.html

Time to Experiment: INTRODUCTION TO THE ROCK CYCLE –



Materials: (you must provide materials unless otherwise noted)
Story of Rock-N-Roll Legend: Roche (provided)
Rock Cycle Picture (provided)
Roche's Journey
Roche Rocks-N-Rolls
Pencils, pens, or crayons for students to write or draw with.

Procedure:
1. Read the story of Rock-N-Roll Legend: Roche (French for rock – pronounced like Ro' sh ay) 627 words long.
2. Using Roche's Journey sheet provided as a guide, photocopy so each student has their own sheet and help them complete their own rock cycle, while you read the story (Roche).
3. Check your students' knowledge by having them answer questions about Roche and how he rocked-n-rolled using the sheet provided.

Extensions:
1. If your students have computer/internet access – they can go investigate the rock cycle in a fun and interesting way at:
http://www.bbc.co.uk/schools/gcsebitesize/chemistry/changestoearthandatmosphere/0rocksrev5.shtml
2. Discover what chocolate and rocks have in common with these wonderful experiments:
http://geologyonline.museum.state.il.us/tools/lessons/2.4/lesson.html
3. For an unforgettable rock-cookie recipe check out
http://www.task.uaf.edu/docs/chocolateChipCookie-RockCycleModule.doc

Conclusions:
Your students should be able to identify and label all the parts of the rock cycle that contributes to building a delta after they have completed the following experiments.

The delta of the Mississippi River created all the land south of Baton Rouge. Baton Rouge is the city where the continental shelf of the United States ends and the Mississippi River delta lands begin.

The Story of Rock-N-Roll Legend: Roche

Here in south Louisiana we have no big rocks – everything is pretty flat, and there are no boulders anywhere. But what most folks don't realize is that we have rocks – tons of them! Well, you may be wondering where they are, but they're right under your feet, so small and so mixed together it's hard to tell they're rocks.

My tale begins a long way away, and a long time ago with a mountain. For thousands of years, the mountain has felt the rain in summer, the frozen grip of ice in winter, and the mad rush of melting waters in spring. The mountain which seems so solid and rigid is actually changing all the time. In the summer rains, water droplets wear the rock of the mountain down. In the winter, water slips into cracks and crevices, and as it freezes splits the mountain apart. In the spring when the snow melts and rushes head-long down the side of the mountain, it can make mud-slides, and wash away trees, ground, and rocks.

When he was young, Roche lived on such a mountain. He loved his home but he longed for adventure, to see the big world – he wanted to rock-n-roll. Then one day he met a water droplet, Gotita from Spain. She told him how she had been all over the world, and Roche decided he must go.

So in the spring flood, they set off together, water and rock down the mountain. On the trip down Roche rolled and rolled and little bits of Roche broke off, but it didn't hurt. Actually it felt great, and the smaller and smoother he was the faster he went. He fell into a river and was pushed along over many other rocks, and they polished him, so he was shiny and fancy and rolled along much easier. Then it happened: he was rolling along when suddenly he fell over the edge of a waterfall and smashed into the pool below.

But our hero was not gone, simply smaller, much smaller, and now he raced along, he and Gotita hurrying along at speeds he could not imagine! But where were they headed? He did not know, but Gotita did. She told him of the wonderful land that reached into the sea. Roche didn't even know what the sea was, but he was excited to find out. He wanted to be part of this brave new land! Gotita promised him he would be.

They left the mountain where Roche was from and traveled along huge fields with golden grass swaying in the winds. They bumped into big heavy barges carrying wheat all the way to the seaport of New Orleans. They heard the beautiful calls of migrating geese as they landed beside the river to rest for the night. Soon, however, their speed began to slow. The air smelled different, and there were new sounds and big important tankers pushing their way up river. The air smelled of forest and marsh and swamp.

Roche and Gotita listened to alligators bellow. Roche was afraid at the noise, but Gotita explained that alligators didn't eat rocks. Still, Roche tried to stay far away from those big teeth. And so they continued their journey.

Soon the air smelled different again – like salt - and the water felt different and slowed way down. And Roche felt himself falling. The slower the river went, the further Roche fell. Gotita stayed with him until he touched the bottom, and something amazing happened – he met old friends from the mountains, and new friends from other mountains. Soon all the friends settled together, and although they were very small, together they were huge – together they formed land, a special land called a delta, and Roche knew he was a rock that had rolled!

Name: Date:

Student Sheet

Roche's Journey

Word Bank

EROSION SEDIMENT DELTA TRANSPORTED

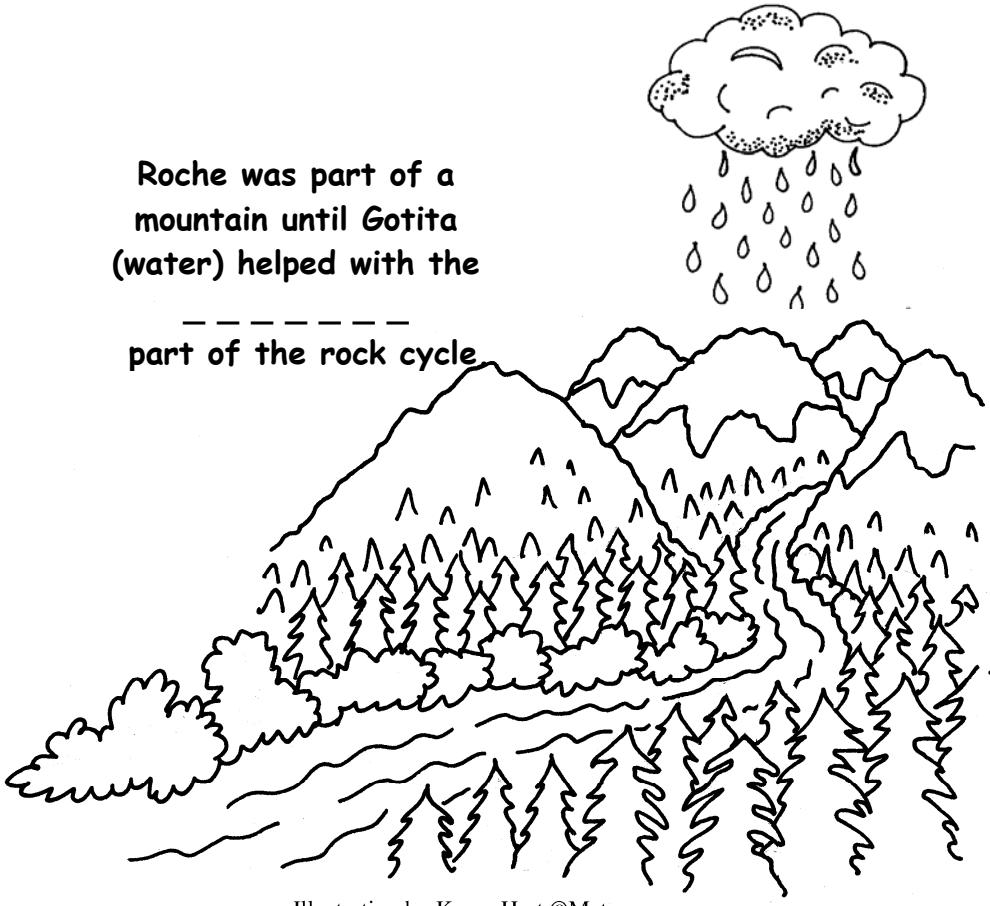


Illustration by Karen Hart ©Metro
Image Credit: Oregon Department of Environmental Quality

Roche was part of a mountain until Gotita (water) helped with the

_ _ _ _ _ _ _ _

part of the rock cycle

Roche and Gotita (water) flowed into a river from a mountain, and were

_ _ _ _ _ _ _ _ _ _ _ _

towards the sea.

The longer Roche was in the river, the smaller he became, until he was so small he was

_ _ _ _ _ _ _ _ _.

When the river reached the sea, Roche fell to the bottom and became part of the

_ _ _ _ _.

Instructor Sheet

Roche's Journey

Word Bank

EROSION SEDIMENT DELTA TRANSPORTED

Roche was part of a mountain until Gotita (water) helped with the **E R O S I O N** part of the rock cycle.

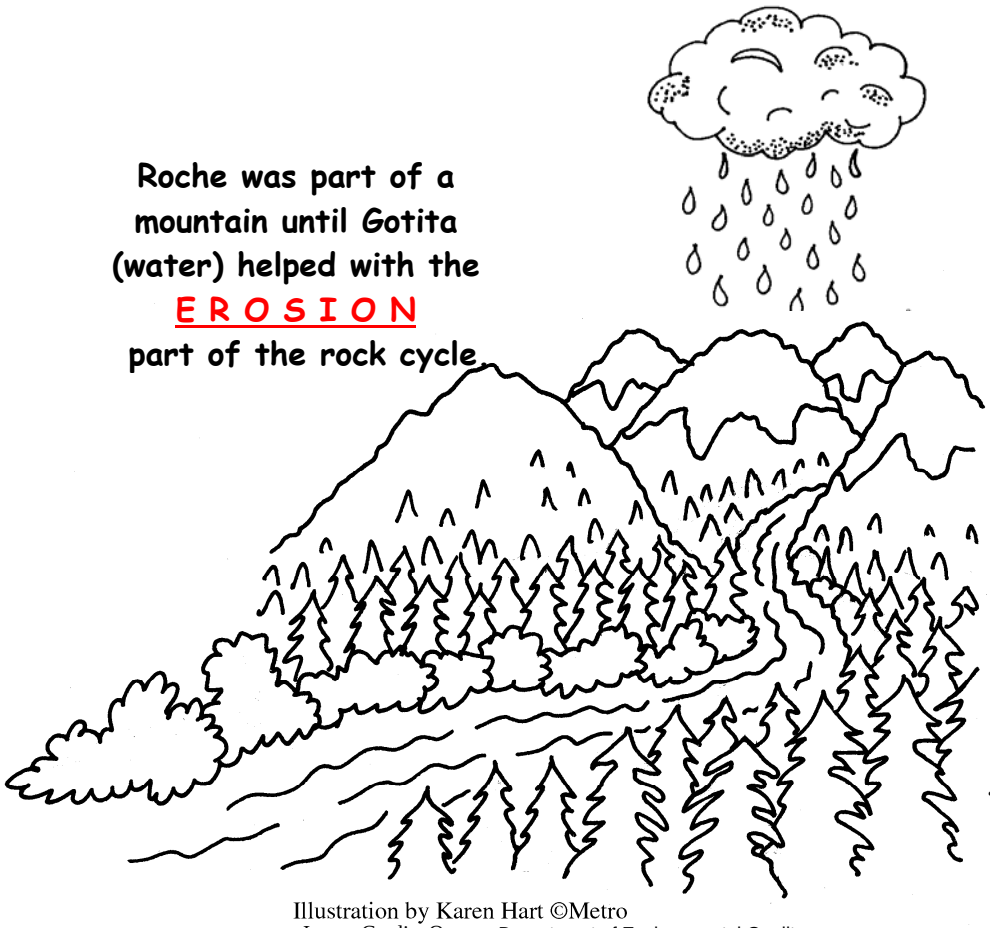


Illustration by Karen Hart ©Metro
Image Credit: Oregon Department of Environmental Quality

Roche and Gotita (water) flowed into a river from a mountain, and were **T R A N S P O R T E D** towards the sea.

The longer Roche was in the river, the smaller he became, until he was so small he was **S E D I M E N T.**

When the river reached the sea, Roche fell to the bottom and became part of the **D E L T A.**

Name: Date:

Roche Rocks-N-Rolls

Pick up a rock and look at it carefully. Do you think it's alive like you are?Why/why not?

_____

_____ . (things that are alive – breathe, eat, sleep, some make noise, some can move, etc.)

How can a rock be like you even if it's not alive?

_____

_____ .

(Can it be hot and cold like you? get wet? etc.)

Could Roche have left the mountain without water? How? _____

_____ .

(someone picked him up, he fell off, a bird or animal could pick him up)

In the story, Roche ends up in the Mississippi River delta. What are some sea animals he might meet in the Gulf of Mexico?_____

_____ .

(sea birds, fish, sea turtles, crabs along the beach, etc)

How do you think Roche would feel about meeting new creatures? How do you feel when you meet something or someone new? _____

_____ .

(happy to meet new friends, scared of different creatures, etc)

Instructor Sheet

Roche Rocks-N-Rolls

Pick up a rock and look at it carefully. Do you think it's alive like you are? Why/why not? Rocks are not alive, they do not breathe, eat, or have babies .

(things that are alive – breathe, eat, sleep, some make noise, some can move, etc.)

How can a rock be like you even if it's not alive? Rocks can heat up in the sun, get cold, wet, and it's affected by gravity (rolls downhill, etc).

(Can it be hot and cold like you, get wet, etc.)

Could Roche have left the mountain without water? How? Yes, wind can also erode mountains, but it takes longer.

(someone picked him up, he fell off, a bird or animal could pick him up)

In the story, Roche ends up in the Mississippi River delta.What are some sea animals he might meet in the Gulf of Mexico? Freshwater fish, amphibians (frogs), mammals (deer), birds, reptiles (lizards and alligators),almost any North American animal in the river corridor – wouldn't meet deep sea animals (whales) or African animals (lions, apes, etc), polar animals, etc., except maybe at a zoo or aquarium that uses Mississippi River water .

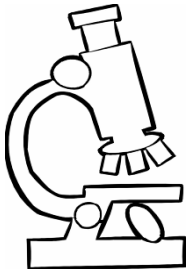
(sea birds, fish, sea turtles, crabs along the beach, etc)

How do you think Roche would feel about meeting new creatures? How do you feel when you meet something or someone new? Scared, excited, interested, etc. Any number of feelings would be appropriate.

(happy to meet new friends, scared of different creatures, etc)

The following experiment will help your students form their own delta, using both the water and the rock cycles.

Time to Experiment: MAKING A DELTA OUT OF A MOUNTAIN



Materials: (you must provide materials unless otherwise noted)

1 Stream Table (provided)
1 length of plastic tubing (provided)
1 watering can
5 gallon bucket for water collection
1 cup
1 50# bag of play sand – sterilized, strained, and screened
Water
Rulers
Plastic grid sheet (provided)
White grid paper
Pencils/crayons

Procedure:

1. **Read all the instructions first.**
2. Put the play sand into a bucket/container
3. Get out the cup
4. Set the delta table on a waterproof surface
5. Attach one end of the plastic tube to the brass nozzle of the delta table
6. Run the other end of the tube into the collection 5 gallon bucket
7. Get cup
8. Fill the watering can with water and set aside
9. Have students line up in front of sand collection in single file
10. One at a time, have students get a cupful of sand and put it at one end of the delta table
11. The "mountain" of sand should not be taller than the edge of the delta table – or else it will spill out
12. When all the students have put their cupful in the table – you should have a "mountain"

13. Then starting at the beginning of the line, again, have the students slowly pour water from a watering can (for about 10 seconds) like a rain shower over one side of the mountain towards the empty side of the delta table
14. After the "mountain" has eroded from the "rain" you should see a delta form towards the once empty end of the table.

15. For younger students have them draw the general shape of the delta formed
16. For older students:
    a. take the plastic grid sheet and lay it over the delta your students formed
    b. have your students draw the delta formed on a piece of grid paper and describe its shape (fan, arc, bird's foot, etc.)
    c. have your students measure the delta and determine the area, using the grid they drew

Extensions:

1. Have your students watch what happens with pollution runoff from farms, etc. (Delta Pollution Extension Activity)

Conclusions:

Your students should be able to identify:

1. how erosion from the rock cycle and rain from the water cycle work together to create sediment from mountains that wash down into rivers.
2. how the Mississippi river then carries this sediment out to the Gulf of Mexico and forms the delta on which we live.
3. how the materials in our Mississippi delta originated from other areas in the United States.

Delta Pollution Extension Activity:

Time to Experiment: POLLUTION IN OUR DELTA –

Materials: (you must provide materials unless otherwise noted)
Delta table with delta that your students just created
Packets of unsweetened drink mixes - get 2 or 3 different colors – dark works best, i.e. red, blue, purple, green, etc. (You may wish to save leftovers for Sugar Cube Extension Activity).
Student worksheet (provided)
Instructor's worksheet (provided)

Procedure:

1. Read all the instructions first
2. After your delta is formed and the mountain partially eroded, you can show your students how farming operations or other ground based-operations can leach pollutants into our waterways
3. Make holes in the sand from the mountain but "upriver" from the delta, and pour one color of drink mix in the hole. Repeat as many times as you wish.
4. Explain that pollutants can be below the ground, like pesticides absorbed by plants. The plants store them under ground in their roots, and when a rain comes these pollutants can be dislodged and flow into the river. Eventually they end up in the delta, where everything drops out before the river enters the sea.

In this experiment you can see the green "pollutant" is leaching out of the ground and running into the "river" that has formed the delta (not visible in this photo).

Image credit: National Park Service

Name: Date:

Student Observation Sheet: Pollution in Our Delta

Delta Table:

I predict (think will happen) I observe (saw what happened)

1. With the first watering of the land, one student pours water on the mountain

Observation 1 _____ Observation 1 _____

_____ _____

2. With more water on the land, after five students have poured

Observation 2 _____ Observation 2 _____

_____ _____

3. After 10 students have poured water

Observation 3 _____ Observation 3 _____

_____ _____

4. After all the class has finished pouring water

Observation 4 _____ Observation 4 _____

_____ _____

Conclusions (What happened and why):

What really happened:

At first I saw water erode the side of the mountain, and then

_____

_____

After five students had poured water, the erosion process started exposing more _____

_____

After 10 students had poured water, the erosion process continued and exposed more _____

_____

After the entire class had poured water, the erosion process brought even more _____

_____

Instructor Sheet: Pollution in Our Delta

Delta Table:

I predict (think will happen) I observe (saw what happened)

1. With the first watering of the land, one student pours water on the mountain

Observation 1 **Answers will vary** Observation 1 **Erosion begins; may or may not see any colors**

2. With more water on the land, after five students have poured water

Observation 2**Answers will vary** Observation 2**Erosion continues; will see some colors**

3. After 10 students have poured water

Observation 3 **Answers will vary** Observation 3**Erosion continues; will see more colors**

4. After all the class has finished pouring water

Observation 4 **Answers will vary** Observation 4**Erosion continues; will see many colors**

Conclusions (What happened and why):

What really happened:

At first I saw water erode the side of the mountain, and then **water and sediment from the mountain slide down. May see some colors exposed; this happened because pollutants in the ground were being exposed by erosion**

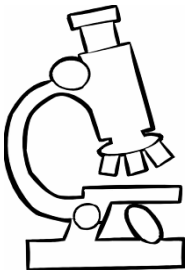
After five students had poured water, the erosion process started exposing more **colors because pollutants in the ground were being exposed by erosion. The more erosion the more exposure; the more exposure the more run-off, (begin to see some colors running into the delta).**

After 10 students had poured water, the erosion process continued and exposed more **colors because pollutants in the ground were being exposed by erosion. The more erosion the more exposure, the more exposure the more run-off, (should clearly see colors running into the delta).**

After the entire class had poured water the erosion process brought even more **colors because pollutants in the ground were being exposed by erosion. The more erosion the more exposure: the more exposure the more run-off, (should clearly see colors running into the delta).**

Rock Cycle Sugar Cube Extension Activity:

To help your students more fully appreciate the impact of mechanical erosion on the rock cycle and the formation of sediment, try the following "sweet" experiment.



Time to Experiment: ROCK CYCLE SUGAR-CUBE

Materials:
Sugar cubes (sold in most stores, usually in a box, in the sugar aisle)
Clear plastic cup with lid
$\frac{1}{4}$ tsp of water
Optional – After the sugar cubes have dissolved, make drinks.
- -the leftover colored drink mix (from the Delta Pollution extension activity)
- -individual cups of water
- -teaspoons

Procedure:
1. Place one sugar cube into the cup
2. Add $\frac{1}{4}$ tsp of water
3. Place the lid on the cup
4. Pass the cup around and have the students shake it for 5-10 seconds (it's longer than you think!)
5. At various intervals (i.e. after every five students finish), look at the cup and the cube. Have the students record their observations (or the whole class can record them)
6. After the cube has totally disappeared, ask your students what happened. (The cube, just like Roche in the story, wore down into smaller and smaller particles (pieces).)
7. If you like, have the students take a teaspoon of the water and taste it, then take a teaspoon of the colored drink mixes and taste it (it should be tasteless or a little bitter). Then make sugared drinks, pass out cups of water, and have each student take a teaspoon of "sugar-rock" water and colored drink mix and mix together. You don't need the colored drink mix, you can just make sugar-water (the kids will love it).

Conclusions:
Your students should be able to identify how the rock and water cycles combine to create sediment.

Image Credit: NATIONAL INSTITUE OF HEALTH

Name: Date:

Student Observation Sheet: Sugar Cube Extension Activity

Sugar Cube and Water in Container:

The students can write or draw what they see after different intervals of shaking the sugar cube and water container:

I predict (think will happen)

I observe (saw what happened) – Observation 1 Time:

I observe (saw what happened) - Observation 2 Time:

I observe (saw what happened) – Observation 3 Time:

Conclusions (What happened and why):

What really happened:

When the sugar cube changed it became (smaller, larger, or stayed the same) _____

_____

I think this happened because _____

_____

Instructor Sheet: Sugar Cube Extension Activity

Sugar Cube and Water in Container:

The students can write or draw the results of the experiment:

May have to help your students with ideas and vocabulary for their observations

I predict (think will happen)

Something along the lines of: the sugar cube will get smaller because we're breaking it up, etc.

Picture of:

Broken sugar cube, or large cube, then smaller, with sugar in the bottom of the container.

I observe (saw what happened) – **be sure your students note what time it is, or how much time has passed (one minute, two minutes, etc.)**

Something along the lines of: Erosion will happen because the sugar cube (like Roche) is being bumped and worn away by the water and the shaking

Picture of:

Sugar-cube in various stages of "erosion."

Conclusions (What happened and why):

What really happened:

When sugar cube changed it became (smaller, larger, stayed the same)

Smaller through mechanical wasting. Larger things become smaller. This is erosion in nature.

I think this happened because Answers will vary – but try to help them understand why when they shook the container, the "knocking" action made the sugar cube get smaller and the water also made it dissolve.

Name: Date:

Journal Making Extension Activity:

Time to Experiment: MAKING A STUDENT JOURNAL

Materials: (you must provide materials unless otherwise noted)
2 sheets of colored construction paper
Multiple sheets of white copy paper (for the inside pages)
Photocopy of Activity/Experiment Sheets (for the inside pages)
2 or 3 ring hole-puncher
Chenille stems (cut into 2 or 3 pieces depending on the number of holes)
Pencils, pens, or crayons
Scissors
Glue
Stickers, magazines they can cut up, pictures from the internet, etc.

Procedure:

1. Help your students create their own journals to use: color front and back pages and add stickers or artwork and then twist the chenille stem pieces through the holes to attach pages and front and back covers together.
2. Have your students draw or write answers to questions after they finish each section of the Traveling Trunk.
3. Hole punch their pages so they can add them to their journals.
4. Add the pages to their journals with the chenille stem pieces.

Conclusions:
Your students should be create and add to their journals about all they have learned after they complete the experiments and activities in the Traveling Trunk .

Questions about Earth Forces!

1. Now that you know you live on a delta, formed by the forces of water and rock – how do you feel about that?
2. Write or draw a story about a rock coming down to Louisiana: what kinds of things do you think she would see, hear, or even taste?
3. Write or draw a story about a rock going through the rock cycle: what would it feel like to melt and form into something new?

Benchmarks and Grade Level Expectations

Benchmarks K-4

Science as Inquiry

A. Abilities Necessary to do Scientific Inquiry

SI-E-A1	Asking appropriate questions about organisms and events in the environment.
SI-E-A2	Planning and/or designing and conducting a scientific investigation.
SI-E-A3	Communicating that observations are made with one's senses.
SI-E-A6	Communicating observations and experiments in oral and written formats.
SI-E-A7	Utilizing safety procedures during experiments.

B. Understanding Scientific Inquiry

SI-E-B5	Presenting the results of experiments.
SI-E-B6	Reviewing and asking questions about the results of investigations.

Physical Science

A. Properties of Objects and Materials

PS-E-A4	Describing the properties of the different states of matter and identifying the conditions that cause matter to change states.

Earth and Space Science

A. Properties of Earth Materials

ESS-E-A3	Investigating, observing, and describing how water changes from one form to another and interacts with the atmosphere.
ESS-E-A2	Locate and compare the relative proportions of land and water found on Earth
ESS-E-A1	Describe earth processes that have affected selected physical features in students' neighborhoods (e.g., rusting, weathering, erosion)

Science and the Environment

SE-E-A5	Describe ways in which habitat loss or change can occur as a result of natural events or human impact

Visual Arts: Creative Expression

VA-CE-E1	Explore and identify imagery from a variety of sources and create visual representations; (2, 3)
VA-CE-E2	Explore and discuss techniques and technologies for visual expression and communication; (1, 2, 3)
VA-CE-E5	Draw on imagination, individual experience, and group activities to generate ideas for visual expression; (1, 4, 5)
VA-CE-E6	Identify relationships among visual arts, other arts, and disciplines outside the arts; (1, 4)

Grade Level Expectations K-4

Science as Inquiry

Abilities Necessary to do Scientific Inquiry

K	1	2	3	4	
1	1	1	1	1	Ask questions about objects and events in the environment
2	2	2	2	2	Pose questions that can be answered by using students' own observations, scientific knowledge, and testable scientific investigations
4	5	6	6	7	Use the five senses to describe observations
6	7	8	8	9	Select and use developmentally appropriate equipment and tools (e.g., magnifying lenses, microscopes, graduated cylinders) and units of measurement to observe and collect data
7	8	9	9	10	Express data in a variety of ways by constructing illustrations, graphs, charts, tables, concept maps, and oral and written explanations as appropriate
8	9	10	11	12	Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios)
9	10	11	12	13	Identify and use appropriate safety procedures and equipment when conducting investigations (e.g., gloves, goggles, hair ties)

Understanding Scientific Inquiry

K	1	2	3	4	
			13	14	Identify questions that need to be explained through further inquiry
			14	15	Distinguish between what is known and what is unknown in scientific investigations
				20	Determine whether further investigations are needed to draw valid conclusions

Physical Science

Properties of Objects and Materials

K	1	2	3	4	
		16			Observe and describe common properties of solids, liquids, and gases
		17			Sort and classify objects by their state of matter
			22		Investigate and explain conditions under which matter changes physical states: heating, freezing, evaporating, condensing, boiling

Earth and Space Science

Properties of Earth Materials

K	1	2	3	4	
	37				Illustrate how water changes from one form to another (e.g., freezing, melting, evaporating)
		39			Design an experiment involving evaporation
			48		Identify examples of the processes of a water cycle (e.g., evaporation, condensation, precipitation, collection of runoff)
				58	Draw, label, and explain the components of a water cycle

Objects in the Sky

K	1	2	3	4	
32					Discuss and differentiate objects seen in the day and/or night sky (e.g., clouds, sun, stars, moon)
		43			Describe characteristics of the sun, stars, and Earth's moon (e.g., relative size, shape, color, production of light/heat)