

4: Neither Wind Nor Rain

Based on the North Dakota quarter reverse



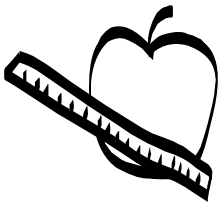
OBJECTIVES

Students will understand the effects of wind and water on landforms in the Badlands and elsewhere.



MATERIALS

- 1 overhead projector
- 1 overhead transparency of each of the following:
 - “North Dakota Quarter Reverse” page (or photocopy)
 - “Go With the Flow” worksheet
 - “Badlands Background” fact sheet
- Copies of the following worksheets:
 - “Go With the Flow”
 - “Badlands—Student Notes”
 - “Wind Blown”
- 1 class map of the United States
- Chart paper
- Markers
- Physical map of North Dakota
- Color images of the Badlands
- Copy of a text that gives basic information about the Badlands, weathering, and erosion, such as:
 - *Disappearing Mountain and Other Earth Mysteries: Erosion and Weathering* by Louise Spilsbury and Richard Spilsbury.
 - *Earth: The Ever-Changing Planet* by Donald M. Silver
 - *Learning about Rocks, Weathering and Erosion with Graphic Organizers* by Diana Estigarribia
 - *Badlands: Beauty Carved from Nature (Doors to America’s Past Series)* by Linda Wade
 - *Badlands of the High Plains* by Chuck Haney
- Medium-size cardboard box
- Magazine
- Small desk fan
- Plastic rectangular planter box, as long as possible, with a quarter-inch hole in one of the short sides



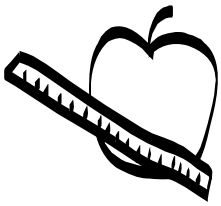
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- Baking pan
- Coffee filter
- Sand
- Smooth pebbles
- Rough gravel
- Stack of books allowing for a 3-inch and 6-inch pile
- Ruler
- 5 to 6 cups of water
- Measuring cup
- 3 rocks, 3 to 5 inches in diameter (small enough to fit in the planter box)
- Newspaper
- Tape
- Small shovel or trowel
- Paper towels
- Highlighters
- Journals
- Pencils



PREPARATIONS

- Make copies of the following:
 - “Badlands—Student Notes” worksheet (1 per student)
 - “Wind Blown” worksheet (1 per student)
 - “Go With the Flow—Erosion Investigation” worksheet (1 per student)
- Make an overhead transparency of each of the following:
 - “North Dakota Quarter Reverse” page
 - “Badlands Background” fact sheet
 - “Go With the Flow—Erosion Investigation” worksheet
- Gather color images of the Badlands, especially those in North Dakota.
- Locate texts that give basic information about the Badlands, weathering, and erosion and have them available in the classroom (see examples under “Materials”).
- Bookmark Internet sites about the Badlands.
- Bookmark Internet sites about erosion.
- Review the content of the “Badlands Background” fact sheet for background information before Session 1.



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- Remove the top and one of the sides from a medium-size cardboard box for the experiment in Session 2.
- Set up the lab stations prior to Session 3.



GROUPINGS

- Whole group
- Pairs
- Individual work



CLASS TIME

Three 45- to 60-minute sessions



CONNECTIONS

Science



TERMS AND CONCEPTS

- Tablelands
- Badlands
- Geology
- Erosion



BACKGROUND KNOWLEDGE

Students should have a basic knowledge of:

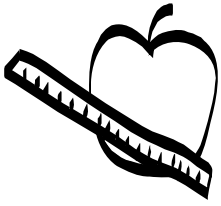
- Bison
- Science experiments
- Predicting
- Observing



STEPS

Session 1

1. Describe the 50 State Quarters® Program for background information, if necessary, using the example of your own state, if available. Locate North Dakota on a classroom map. Note its position in relation to your school's location.

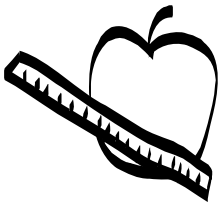


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2. Display the “North Dakota Quarter Reverse” overhead transparency or photocopy. Examine the design and have the students identify the images, including the sun, the landforms (the Badlands), and the two bison.
3. Ask the students why they think these images might be important to North Dakota, and accept all responses. Have students brainstorm what they know about bison. Lead a class discussion on the difference between a buffalo and a bison. Include the idea that the buffalo is genetically a cousin to the bison, but they are different animals. Only the bison is native to the United States, but the American bison is often called a buffalo.
4. On a class map, locate the Badlands in the western part of North Dakota.
5. Display the images of the Badlands for the students. Tell the students that the Badlands are known for their beauty and ruggedness. The Badlands were formed by erosion when bursts of heavy rain were followed by periods of drought.
6. Discuss the characteristics of the Badlands that can be noted from the images. Record the student responses on chart paper.
7. Display the “Badlands Background” fact sheet overhead transparency and distribute a “Badlands—Student Notes” worksheet to each student.
8. Discuss and highlight the content of the fact sheet with the students. Emphasize that the Badlands were created sixty million years ago and shaped by erosion.
9. Direct the students to complete the worksheet during the class discussion of the Badlands.
10. Allow time for the students to complete their worksheets.
11. Display the “Badlands—Student Notes” overhead transparency. Review the answers as a class.
12. Collect the students’ worksheets.

Session 2

1. Display the images of the Badlands and the “Badlands Background” fact sheet overhead transparency. Review the material covered in session 1.
2. Write the word “erosion” on a piece of chart paper. Have the students get into pairs and briefly brainstorm all that they know about erosion.
3. As a class, discuss the ideas brainstormed and create a definition for “erosion.” Record the student responses on the chart paper.
4. Discuss the following with the students to ensure they understand these points:
 - Erosion is the process that shapes the Earth.
 - Erosion can happen quickly or gradually over time.
 - Wind and water are two sources of erosion.
 - Waves and glaciers (ice) can also reshape the land.
5. Have the students summarize what they learned about erosion and apply that information



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to what they've learned about the Badlands. Students should know that the Badlands were shaped by erosion.

6. Distribute a "Wind Blown" worksheet to each student. Explain that you will be using sand to demonstrate wind erosion.

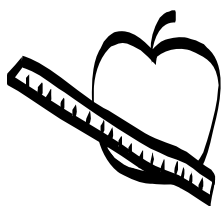
Note: If there is enough time and supplies, the students can work together in small groups to complete the science experiments.

7. Review the terms "prediction" (what they think will happen) and "observation" (what actually happens) with the students. Tell the students they will need to predict and record observations throughout the demonstration.
8. Display a medium-sized cardboard box with its top and one side removed. Pour a pile of sand in the center of the bottom of the box.
9. Before each of the steps, tell the students to predict what will happen and allow them time to record their observation after each step.
10. Tell the students you are going to move air over the sand from the open side of the box to simulate wind on a desert or beach.
11. Ask three students blow lightly for 5 to 10 seconds at the same time over the sand from the open side of the box. Have all the students record their observations.
12. Ask a student to take the magazine and wave it up and down into the box for 5 to 10 seconds. Record observations.
13. Place the small desk fan by the open side of the box and briefly turn it on low for 5 to 10 seconds. Record observations.
14. Ask the students if the experiment would have different outcomes if smooth pebbles or rough gravel were used and record their predictions. Discuss the responses. Repeat the process with the other two substances.
15. Ask the students to summarize what happened in the "Wind Blown" experiment. Ask the students to suggest some places in the world where sand would be affected by wind erosion. Answers can include any specific beach or desert.
16. Allow the students sufficient time to complete their worksheets. Review the answers as a class and collect the worksheets.

Note: Assemble the materials for the water erosion experiment before Session 3 begins. You'll want to prepare an area with newspaper spread on the floor, where wet sand can be shoveled back into bags, and paper towels or a sink so the assistants can clean their hands. You might also apply the coffee filter and newspaper in advance (see step 8).

Session 3

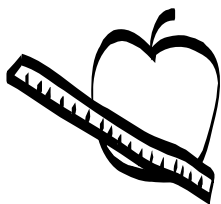
1. Review the material covered in the first two sessions.
2. Tell the students that they will be conducting an investigation to learn more about water



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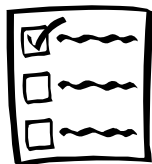
erosion and how it can affect landforms. Tell the students they will need to compare the results of the “Wind Blown” experiment with today’s “Go With the Flow” experiment.

3. Display the “Go With the Flow” overhead transparency and distribute a “Go With the Flow” worksheet to each student.
4. Review the worksheet and the steps for the investigation with the students.
5. Have the students make their initial predictions based on class discussions and prior knowledge.
6. As a class, conduct the experiment, allowing sufficient time for the students to record their observations.
7. Ask for a couple of student volunteers to assist with this experiment. (This activity will be demonstrated by the teacher with two student assistants. Have the assistants write “assistant” on their worksheet for exemption or watch a videotape of the experiment later and fill out their worksheets. The other students watch with their copies of the worksheet.)
8. Tape the coffee filter to the inside of the planter box over the hole to keep the sand from running out. Place some newspaper on the experiment table to protect it from spills.
9. Have one assistant fill the planter with sand to just below the hole. Have both assistants press on the sand to pack it down. Place the planter so that the end with the hole is in the baking pan (to catch the water) and the other is on a pile of books 3 inches high.
10. Have the other assistant pour one cup of water onto the sand at the raised end of the planter box. Observe what happens. (Water creates channels in the sand.) Have the students record and draw their observations on the worksheet. Have them check whether their prediction was correct.
11. Have the second assistant smooth out the sand, add books to the stack under the planter box until the upper end is 6 inches high, empty the baking pan, and replace it under the planter box.
12. Have the first assistant pour one cup of water onto the sand at the upper end of the box. Observe what happens. (Water moves faster and channels are deeper.) Have the students record and draw their observations on the worksheet. Have them check whether their prediction was correct.
13. Continuing to alternate the assistants, have them smooth out the sand, push a rock into the sand near the middle of the planter box, empty the pan, and replace it.
14. Pour two cups of water on the sand. Observe what happens. (Rock diverts the water. The stream is divided into two channels. Erosion is occurring around the rock.) Have the students record and draw their observations on the worksheet. Have them check whether their prediction was correct.
15. While the assistants empty the planter of the wet sand, have the other students predict what will happen when you use rough gravel or smooth pebbles instead of sand. Repeat the experiments for each substance.



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16. Allow sufficient time for the students to complete their investigation worksheets and the assistants to clean up the experiment table.
17. Display the color images of the Badlands again. As a class, summarize the findings of the two experiments and how they relate to the Badlands and other areas. In the Badlands, the difference is not so much between sand and rock as between harder and softer rocks. One type of rock is called “sandstone.” Sandstone can be hard, but it can also be very soft—soft enough to erode much more quickly than other types of rock.
19. Collect the students’ worksheets.



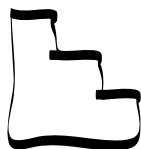
ASSESSMENT

- Take anecdotal notes about the students’ participation in class discussions.
- Evaluate the students’ worksheets and lab worksheets for their achievement of the lessons objectives.



ENRICHMENTS/EXTENSIONS

- Have students create a watercolor painting showing the beauty of the Badlands.
- Have students research details of Teddy Roosevelt’s views on conservation and the Badlands of North Dakota.
- Have students build a mountain made to hold up when a large container full of water is poured over it. Students can build their mountains out of sand, pebbles, gravel, or a combination of two substances.



DIFFERENTIATED LEARNING OPTIONS

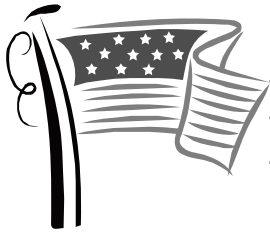
- Allow students to work with partners to complete their lab sheets.
- Allow students to dictate their written responses to a scribe.
- Videotape the experiments for the students who are absent or need to watch them again to accurately record their observations.



CONNECTION TO WWW.USMINT.GOV/KIDS

Invite students to visit “Coin of the Month” and look at other coins that feature bison such as:

- Kansas quarter at www.usmint.gov/kids/index.cfm?fileContents=coinNews/cotm/2005/09.cfm.
- American Bison Nickel at www.usmint.gov/kids/index.cfm?fileContents=coinNews/cotm/2005/03.cfm.
- Indian Head/Buffalo Nickel (1913–1937) at www.usmint.gov/kids/index.cfm?fileContents=coinNews/cotm/2001/06.cfm.



Badlands Background

Fact Sheet

"This broken country has been called always—by Indians, French voyagers, and American trappers alike—'the bad lands.'"

—Teddy Roosevelt

The Badlands, partly located in southwestern North Dakota, are known for their beauty and ruggedness. The Badlands were formed by erosion when bursts of heavy rain were followed by periods of drought.

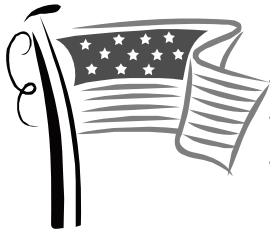
The Badlands first began forming about 60 million years ago when streams carried eroded materials eastward from the Rocky Mountains and deposited them on the Great Plains. Warm, rainy periods followed and dense vegetation grew, fell into swamp areas, and was later buried by new layers of sediment. Some of this plant life became petrified. (Today, considerable amounts of petrified wood can be seen in the Badlands.) Sediments were being deposited, and streams were starting to cut through and sculpt the land, forming these typical Badlands features:

- **Buttes** (pronounced BYOOTS)—isolated hills or mountains with steep sides, usually having smaller tops than mesas have.
- **Mesas, plateaus, or tablelands**—broad, level, elevated areas with one or more cliff-like sides. "Mesa" is Spanish for "table." "Plateau" is French for "platter."
- **Valleys**—large depressions in the earth, usually between ranges of hills or mountains.

Yearly **precipitation** in the Badlands averages 15 inches. Rain, though infrequent, usually comes in hard downpours that cause erosion. Running water is still changing the Badlands. Water runs down slopes and causes gullies; some of it soaks into clay-rich rocks and soil, weakening them and eventually making them flow downhill. As a result, the soil is very loose and crumbly. The rivers and streams cut into cliff sides and carry away sand and silt brought in by smaller tributaries.

The Badlands are home to a great variety of creatures and plants. Rainfall, although light, does nourish the grasses that cover the land. Wildflowers can be found here as well as over 180 species of birds, many of them songbirds. Mule deer, white-tail deer, prairie dogs, bison, and elk also live here.

Erosion is the process that shapes the Earth by moving rock and soil from one place to another. One of the major causes of erosion is running water. Rainwater collects in channels on the steep slopes of mountains. These channels become streams and rivers, which cut into the surface of the rock. The rivers then carry particles or rock and soil downstream. Because some rocks are harder than others, the rivers wear the rock away unevenly. Over time, the rivers can form deep valleys and canyons.



Name _____

Badlands

Student Notes

Directions: Review and highlight key parts of the vocabulary. Answer the questions based on the class discussion and the available resources.



VOCABULARY

Badlands: Deeply eroded, barren land

Terrain: Any piece of land

Drought: A prolonged period of dryness

Geology: The scientific study of the origin, history, and structure of the earth

Erosion: A general term applied to the wearing away and movement of earth materials by gravity, wind, water, and ice

Dense: Marked by compactness or crowding together

Sediment: The matter that settles to the bottom of a liquid

Butte: An isolated hill or mountain with steep sides usually having a smaller summit area than a mesa

Mesa, plateau, or tableland: Broad, level elevated area

Precipitation: A deposit on the earth of hail, mist, rain, sleet, or snow

Tributaries: Small streams that lead to a river

Weathering: The breakdown of solid rock at or near the Earth's surface

1. In what part of North Dakota are the Badlands located? _____

2. When did the Badlands first began forming? _____

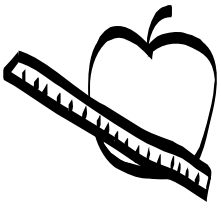
3. How did the Badlands begin to form? _____

4. As sediments were being deposited, what landforms did streams begin to form? _____

5. How many inches of rain fall in the Badlands yearly? _____

6. What continues to change the shape of the Badlands? _____

7. Name three animals that can be found in the Badlands. _____



Name _____

Badlands

Student Notes—Key

Directions: Review and highlight key parts of the vocabulary. Answer the questions based on the class discussion and the available resources.



VOCABULARY

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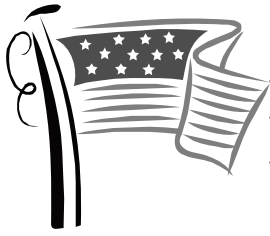
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Tributaries: Small streams that lead to a river

Weathering: The breakdown of solid rock at or near the Earth's surface

1. In what part of North Dakota are the Badlands located? Southwestern
2. When did the Badlands first began forming? About 60 million years ago.
3. How did the Badlands begin to form? Streams carried eroded materials eastward from the Rocky Mountains and deposited them on the Great Plains.
4. As sediments were being deposited, what landforms did streams begin to form?
Buttes, tablelands, and valleys.
5. How many inches of rain fall in the Badlands yearly? 15 inches.
6. What continues to change the shape of the Badlands? Running water.
7. Name three animals that can be found in the Badlands. Mule deer, white-tail deer, bison, prairie dogs, and elk



Name _____

Wind Blown

Directions: Answer these questions based on the experiments done in class.

Define "prediction": _____

Define "observation": _____

What happens when a little bit of air blows on the sand:

Predict what will happen as more air blows on the sand:

Note what you observe: _____

Predict the outcome when using pebbles: _____

Note what you observe: _____

Predict the outcome when using gravel: _____

Note what you observe: _____

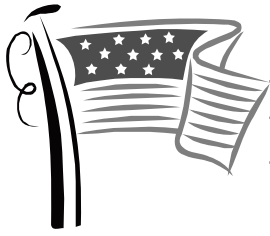
Explain what happened as more air blew over the sand:

Explain what happened when pebbles replaced the sand:

Explain what happened when gravel replaced the sand:

Note which your predictions were correct:

Summarize the results and what you learned about wind erosion:



Name _____

Go With the Flow

Erosion Investigation

Directions: Answer these questions based on the experiments done in class.

1. What happens when the water moves across the surface of the sand?

2. What do you think will happen as you raise one end of the pan higher (angle of the mountain)?

3. How would the slope of a mountainside affect erosion?

4. Do you think the rock will have an affect on the water?

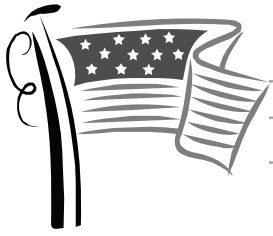
5. How do you think another substance like dirt or small pebbles would affect the outcome?

6. How is this experiment similar to what happens when water shapes the Badlands?

7. In these boxes, illustrate the three stages of the investigation.

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8. Two types of erosion were investigated in class. Which type do you think would erode landforms, like the Badlands, at a faster rate? Explain your answer.



North Dakota Quarter Reverse

