## Observing Change

**IN THE OBSERVING CHANGE WORKSHOP, YOUR STUDENTS INVESTIGATED SOME OF THE FACTORS THAT INFLUENCE HOW WATER FLOW CHANGES THE EARTH’S SURFACE AND CONSIDERED THE ROLE OF HUMAN INTERACTION IN RIVER SYSTEMS. CONTINUE THEIR EXPLORATION OF EROSION PATTERNS, GEOLOGICAL CHANGES, AND THE WAYS PEOPLE CONTROL WATER FLOW WITH THE FOLLOWING DISCUSSIONS AND ACTIVITIES.**

### Discussion: How Does Water Change the Earth?

<table>
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<th>TIME:</th>
<th>10-20 minutes</th>
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<td>GOAL:</td>
<td>Review and discuss concepts encountered during the field trip.</td>
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Review the list of questions the class generated before the field trip.

- Which questions were they able to answer? What did they discover?
- Which questions were not answered during the trip? What new things do they now wonder about?
- How could they find more information about those questions?

Discuss with the class their experiences in the workshop and in the exhibit.

- What did they find out about how rivers and streams change the Earth’s surface? How do those changes affect people?
- What are some of the ways that people change the behavior of rivers and streams?
- How might people’s changes help the environment? How might they be harmful?
# Observing Change

## Research Project: Erosion Journals

**Time:** 20–45 minutes, plus follow-up discussion

**Goal:** Find, observe, and document examples of water-based erosion in local environments.

### Materials:
- Example photos of various types of erosion (an internet image search on “erosion” will produce plenty of examples)
- Observation journals—template below, or use notebooks or stapled packets of loose-leaf paper
- Rulers (optional)
- Camera(s) (optional)

### Procedure:

1. Remind students of the streams they created in the Observing Change workshop. What kinds of shapes, patterns, or landforms did they see in their model landscapes? How did they change over time, or as more water was added?

2. Show photos of various erosion effects. What can students tell about what kind of water process caused each one? (A slow trickle of water vs. a flood, water falling from a height vs. running along the ground, etc.) What makes them think so? Have they seen formations like these anywhere in their own neighborhoods or other places they’ve been? Where did the eroded rock or soil end up? Introduce vocabulary terms for landforms as appropriate.

3. If possible, take the class outside to the schoolyard and/or surrounding neighborhood to look for signs of erosion and deposition. The examples may be large, like a run-off channel carved in a hillside, or small, like an accumulation of dirt at the edge of a storm drain. Ask students to sketch, measure, and/or take notes on the examples they find. Where was it? What shape was it? How big/long/wide? What did the soil look and feel like? How might this formation have been created? If cameras are available, document the examples with photos.

4. Assign students to take their erosion journals home and find more examples of erosion in their neighborhoods. For each example, they should include a sketch or photo, date and location, measurements or estimates (if possible), how they think it might have formed, and any evidence they have to support their hypothesis.
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RESEARCH PROJECT: EROSION JOURNALS

**REFLECTION:**
Ask students to share examples from their journals, and/or look at examples from the class’s initial explorations.
- What similarities and differences are there between examples?
- Are there any patterns to where particular types of formations occur?

**EXTENSION:**
Encourage students to choose one of the examples from their journals to observe over several weeks, or choose a few examples from the class’s initial explorations to observe together. Ask students to make predictions about how the formation might change. What factors might cause it to change? What will it look like? Check on the formation regularly over a period of weeks and record any changes. What changes occurred? How did the different formations behave similarly or differently over time?
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EROSION AND DEPOSITION JOURNAL

DATE: ___________ LOCATION: ________________________

APPEARANCE: ________________________

NOTES:

WHAT MIGHT HAVE CAUSED IT? WHAT MAKES YOU THINK SO?
IN THE **OBSERVING CHANGE** WORKSHOP, STUDENTS EXPLORED THE IMPACT OF TWO MAJOR VARIABLES ON EROSION PATTERNS—SLOPE AND WATER FLOW RATE. IN THIS ACTIVITY, STUDENTS WILL GENERATE IDEAS FOR OTHER VARIABLES THAT MAY INFLUENCE EROSION PATTERNS AND CARRY OUT AN INVESTIGATION INTO THE EFFECTS OF ONE OF THE VARIABLES.

**INVESTIGATION:** EROSION EFFECTS

**TIME:** 30–45 minutes for introduction and experimental design, plus additional time for carrying out investigation.

**GOAL:** Design and carry out an experiment investigating the effects of a changing variable on erosion patterns.

**MATERIALS:**
The materials will depend on students’ experimental design but may include the following:
- Different types of soil—sand, clay, potting soil, etc.
- Trays or shallow bins
- Measuring cups, graduated cylinders, droppers, or other tools for measuring water volume
- Popsicle sticks, sturdy cardboard or plastic, or other materials for building structures

**PROCEDURE:**
1. Introduce the activity by reviewing the students’ experience in the Observing Change workshop. How did changing the slope and changing the water flow rate affect the erosion patterns? Were there any other factors they noticed during the workshop that might have influenced their results? Brainstorm other variables that might have an effect on how erosion occurs. If you have completed the Erosion Journal activity, encourage students to make connections to their observations in the journals.

2. Divide students into pairs or small groups to plan and carry out an investigation on one aspect of soil erosion. They might choose to explore the effects of one of the variables brainstormed by the class (e.g. “How does the depth of the soil affect erosion patterns?”) or test a hypothesis from the Erosion Journal activity (e.g. “What conditions cause narrow, winding channels?”) The following questions may serve as guidelines for planning the investigation:
   - What question do we want to answer? How could we answer it?
   - What kind of model will we use? What will the different parts represent?
   - What variable(s) will we change? What needs to stay the same?
   - What will we measure or observe? How will we record the results?
   - What materials will we need?
3. Supply needed materials to each group—or allow time for students to bring in supplies—and provide class time for setting up and carrying out investigations.

4. Ask students to present their findings, summarizing what they did, what they discovered, and what other questions they now have about their subject.

**REFLECTION:**
The class’s investigations probably used model systems rather than full-scale landscapes.

- In what ways were the models similar to the actual subject? In what ways were they different?
- What conclusions can students draw from these investigations about how erosion happens on the Earth’s surface?
- In what ways might erosion on Earth behave differently from these models?

**EXTENSION:**
Challenge students to design and carry out a second round of investigations, either to gather more information about their initial question or to explore one of the follow-up questions that came out of their first experiment.
Post-visit Resources

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RESEARCH PROJECT: CONTROLLING WATER

TIME: 10–20 minutes to introduce project, plus time for individual presentations

GOAL: Research and present the benefits and drawbacks of a system built by humans to control water flow.

PROCEDURE:

1. Remind students of some of the tools they used in the Observing Change workshop to control where the water went. What did the tools do? What real-life structures were they representing? What other structures or systems do people build to control how water flows?

2. Ask each student to choose a type of structure or system for further research. The list might include: dams, levees, dikes, canals, channels, locks, reservoirs, afforestation (tree planting), managed flooding, green roofs, rain gardens, etc.

3. Research should answer the following questions:
   - What does the structure or system do?
   - What are its parts?
   - What different types or styles of this system are there?
   - What are the pros and cons of this system—for humans and for other plants and animals in the environment?
   - Are there ways that the drawbacks could be fixed or improved? (Students’ own ideas as well as any existing methods)

4. Encourage students to develop a creative way to present their research to the class. Some possible ideas:
   - Build a functioning model of the structure/system out of everyday materials and give a live demonstration of how it works.
   - Create a video advertisement explaining why the structure/system should or should not be built in your area.
   - Write and perform a song, rap, skit, or play about the pros and cons of the structure/system.
   - What will this structure/system look like in the future? Design a new-and-improved version and draw or make a model of it.
REFLECTION:
• What are some of the different reasons people try to control how water flows?
• What are some of the consequences to the ways people control water flow?
• What are some ways to balance the benefits and the drawbacks?

EXTENSION:
Based on the research topics students chose, divide the class into small groups so that each group contains a variety of different water control structures/systems. Each group’s job is to design a town situated on or near a river that includes the structure or system of each person in the group. (For example, if the members of the group researched dams, locks, and rain gardens, then the town should include those three things.)

• What kind of town will it be?
• Where will the structures be located and why?
• Where will houses, stores, parks, and other parts of the town be located?
• What factors have to be kept in mind when planning a town near a river?
Post-visit Resources

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ONLINE RESOURCES

- Example photos of various types of erosion and weathering:
  [Link](http://www.doe.virginia.gov/instruction/gifted_ed/project.promise/science_curriculum/grade_two/handouts/earth_science/weathering_erosion_pictures.pdf)

- “Healthy Rivers” resources from the Minnesota DNR:
  - Geomorphology and river systems:
    [Link](http://files.dnr.state.mn.us/assistance/backyard/healthyrivers/course/200/202_00.htm)
  - Case studies of human intervention in river systems:
    [Link](http://files.dnr.state.mn.us/assistance/backyard/healthyrivers/course/300/300_00.htm)

- An analysis of the Mississippi River from America’s Wetland Foundation:
  [Link](http://www.americaswetlandresources.com/background_facts/detailedstory/MississippiRiverAnatomy.html)

- A student-friendly resource on dams from PBS: [Link](http://www.pbs.org/wgbh/buildingbig/dam/)

- An overview of flood control methods, with photos:
  [Link](http://www.slideshare.net/whiskeyhj/methods-of-flood-control1274)

  (Other related slideshows in the sidebar)

- A resource collection from National Geographic Education on dams and water management:
  [Link](http://education.nationalgeographic.com/education/topics/dams/?ar_a=1)
THE OBSERVING CHANGE WORKSHOP AND THESE ACCOMPANYING RESOURCES SUPPORT THE FOLLOWING ELEMENTS OF THE NEXT GENERATION SCIENCE STANDARDS (HTTP://WWW.NEXTGENSCIENCE.ORG):

**CORE IDEAS**

- **The History of Planet Earth:** Local, regional, and global patterns of rock formations reveal changes over time due to earth forces. (4-ESS1-1)
- **Earth Materials and Systems:** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)
- **Biogeology:** Living things affect the physical characteristics of their regions. (4-ESS2-1)
- **Natural Hazards:** A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2)
- **Designing Solutions to Engineering Problems:** Testing a solution involves investigating how well it performs under a range of likely conditions. (ETS1-B)

**SCIENCE AND ENGINEERING PRACTICES**

- **Asking Questions and Defining Problems:** Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

- **Planning and Carrying Out Investigations:** Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

- **Analyzing and Interpreting Data:** Analyze and interpret data to determine similarities and differences in findings, or to provide evidence for phenomena.

**CROSSCUTTING CONCEPTS**

- **Stability and Change:** Things may change slowly or rapidly (ES); explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales; small changes in one part of a system might cause large changes in another part (MS).

- **Cause and Effect:** Cause and effect relationships are routinely identified, tested, and used to explain change (ES). Cause and effect relationships may be used to predict phenomena in natural systems (MS).

- **Systems and System Models:** Models can be used to represent systems and their interactions.