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Erosion: Beauty or Beast?

Science

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Time Frame	2-3 class period(s)
Duration	120 minutes

Essential Question

What makes the land/Earth surface around us change, move, and wear away?

Summary

Students explore water erosion and investigate erosion and weathering in different types of soil. Funding provided by Agriculture and Food Research Initiative Competitive Grant no. 2013-69002-23146 from the USDA National Institute of Food and Agriculture.

Snapshot

Engage

Students observe earth materials, such as gravel, large-grained sand or pebbles, fine-grain sand, and silt or clay, and discuss similarities and differences.

Explore

Students investigate how soil and rock particles are moved from one place to another.

Explain

Students explain the processes of erosion and weathering by writing summary statements, then read a story and watch a video about erosion and weathering.

Extend

Students investigate which soil types allow greater erosion and look for examples of erosion around their school or school community. Fifth grade students research and propose solutions.

Evaluate

Students explain how their understanding of erosion and weathering have changed as well as provide evidence for their erosion claims.

Standards

Next Generation Science Standards (Grade 4)

4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
: Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Next Generation Science Standards (Grade 4)

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Oklahoma Academic Standards (4th Grade)

4.LS1.1 : Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Oklahoma Academic Standards (4th Grade)

ESS2: Earth's Systems

Attachments

- Article—Is It Erosion.pdf
- Card Sort—Is It Erosion - Spanish.docx
- Card Sort—Is It Erosion - Spanish.pdf
- Card Sort—Is It Erosion.docx
- Card Sort—Is It Erosion.pdf

Materials

- Article—Is It Erosion?(attached; teacher use)
- Card Sort (attached; optional; 1 per small group)
- 25 6-8 oz. paper or plastic cups
- Samples of different type of soil, such as Gravel (limestone); Sand with large pebbles or grains; Fine sand; Fine silt/clay, to fill up cups for each group
- 15 trays (9x13) approximately
- 5 spray bottles filled with water
- 25 straws
- 5 large ice cubes
- Class set of safety goggles
- Small wooden paddle or large craft sticks
- Collect different types of soil from your area, such as sandy loam, clay-like soil, topsoil, silt, or soil with vegetation.

Engage

Teacher's Note: Background

Over time, the soil on the surface of Earth wears away because of weathering and erosion. Weathering is the gradual breaking down of rocks due to rain and other factors. Erosion happens when soil and rock particles are moved from one place to another, sometimes quickly due to a hurricane or flood and sometimes naturally over time. Both wind and water can cause weathering and erosion. Land that is covered with plant life (grass, bushes, trees) has greater protection from erosion than bare land. The roots of trees and bushes hold the soil in place and prevent it from moving to other locations. Land that is along the water often erodes due to a lack of plant life.

Teacher's Note: Prior Knowledge

Students should know that there are different types of soil (sand, clay, silt, loam). They should know that soil is a renewable resource made from organic material and the breaking down of rocks, however, it does take a long time for soil to be made. They should know the four components of soil: weathered rock material, humus/organic material, water, air. Soil is needed to support plant life. Soil conservation is needed to help preserve our soil. Planting trees, grass, and other plants to help reduce erosion can achieve soil conservation.

For each group or table, prepare 4 paper cups with one with gravel, one with large grain sand with pebbles, one with fine-grain sand, and one with soil with silt or clay. Ask the essential question of the class: What makes the land/earth around us change, move, and wear away? Responses may include ice and snow.

Teacher's Note

If using science notebooks have students open their science journals to the Table of Contents and add "How the Earth Changes" under their experiences, then label the next clean page "How the Earth Changes".

Tell students to decide a characteristic to use to place the earth samples in a particular order. Then, tell students to place the cups of earth materials in order using their observations of characteristic.

Have students make notes of their observations of the physical properties of the rocks and soils in the cups in their science journals. They should note properties, such as size, shape and color, noting the similarities and differences. See Figure 1.

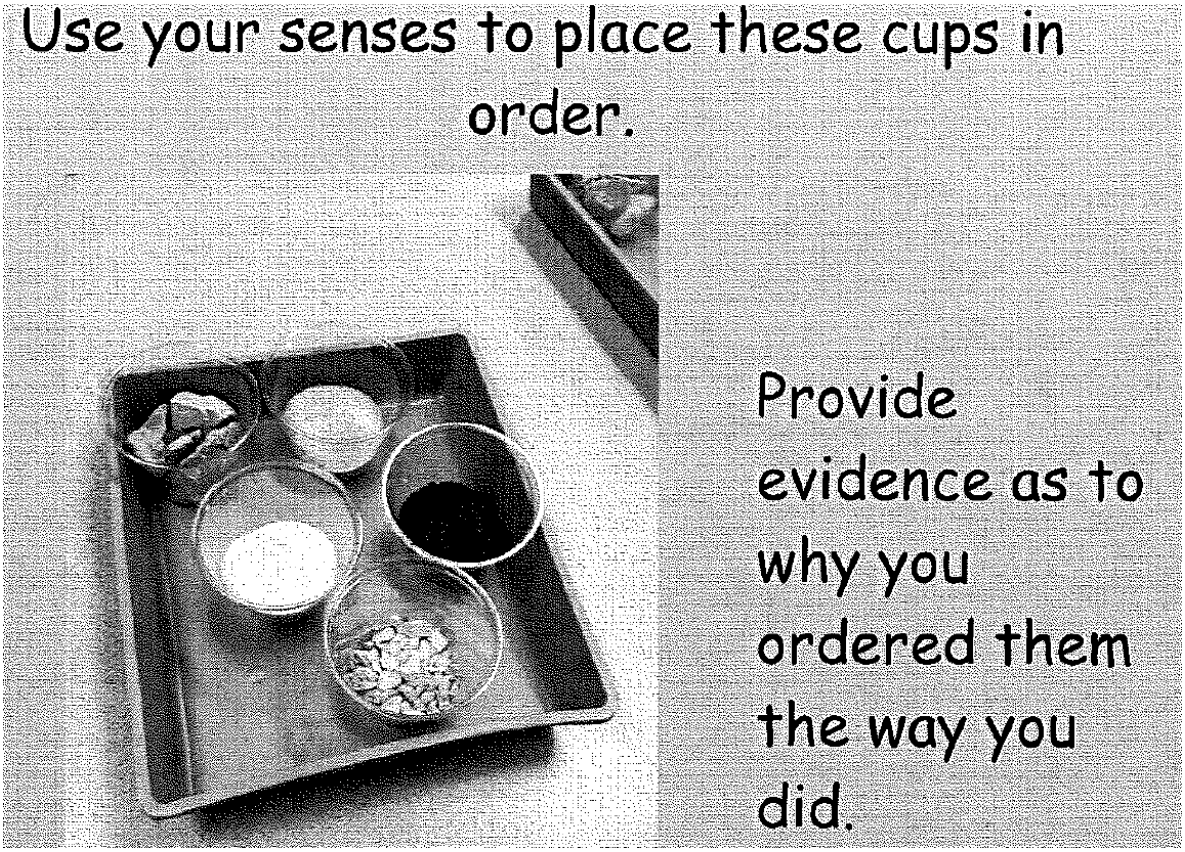

Figure 1. Observing soil properties.

As a group students will provide evidence as to how and why they ordered the cups. Ask: *What was the rule for the way you sorted these? What properties did you notice?* Listen carefully to how they support their reasoning for the ordering of the earth materials. As students are explaining their thinking, record key thoughts and words on chart paper or board using a webbing strategy. See sample in Figure 2.

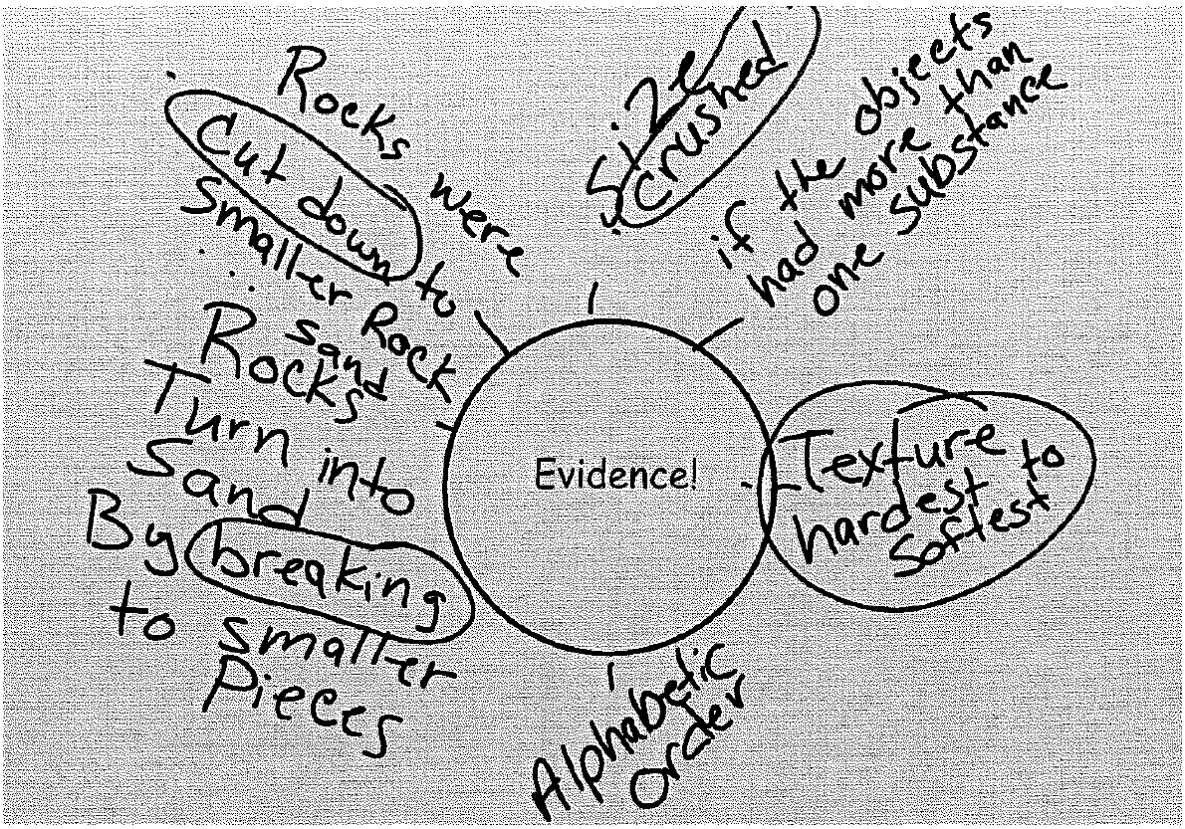

Figure 2. Organizing the Earth's materials.

Teacher's Note

It is okay if students do not use the terms erosion and weathering. The terms weathering and erosion are introduced later. Ask: *How might these rocks get broken down to smaller particles, such as sediment and/or soil? How does the earth's surface change over time?*

Explore

For the Card Sort activity, pass out the attached handout to small groups and have students complete cut the cards out. This formative assessment examines students' thinking before they are introduced to the formal concepts of weathering and erosion. Tell students that each of the cards describes a way that can change rocks, soil, or sediments. Have students discuss the similarities and differences between the cards, but do not provide them with the names of the processes. Encourage students to sort their cards into various categories that describe a similar way that rock, sand, or sediment was changed. Students can name their groups. Have students share their categories for the similar types of changes and listen carefully for evidence of initial ideas about weathering, erosion and deposition even though they may not use the terminology. Have students look for similarities in grouping with the initial activity using the cups of materials. These activities help build a connection between students' initial ideas and the formal concepts and vocabulary of weathering and erosion.

To begin the Explore section, set up these stations at each table and ask students to prepare their science journals by adding a table similar to Figure 3. Have students rotate through each station about every 5 minutes (for larger classes, you may set up duplicate stations). Remind students to wear their goggles and to remember science safety rules.

Station #	Illustration	Observations
1		
2		
3		
4		

Figure 3. Table for recording observations.

Station 1: Provide a 9x13 tray with sand and a spray bottle filled with water. The nozzle of the spray bottle should be set so that the water comes out in a stream, rather than a spray. This will allow for some of the sand to be displaced, imitating erosion. At Station #1, put a card sign that says: Spray water over the sand and observe what happens to the sand. Draw what you observe and write what you noticed in your science journal.

Station 2: Provide a 9x13 tray filled with sand and a large ice cube on top of the sand. At Station #2, put a card sign that says: Observe what happens to the sand where the ice is. Push the ices cube(s) through the sand, imitating glacial erosion. Record your observations in your science journal. Before moving to the next station, move the sand and ice cube back to where they were when you arrived.

Station 3: Set up a small plastic clear aquarium filled with sand built up only on one side, add two cups of water. At Station #3, put a card sign that says: Use the large craft stick to simulate water waves. Record your observations in your journal. Before moving to the next station, move the sand and ice cube back to where they were when you arrived.

Teacher's Note: Station 3

An alternate way to show how waves impact erosion in Station #3 would be to use a wash bottle at this station and spray a constant stream of water in one spot at the top of the sand slope. After a few seconds, something that looks like an alluvial fan will form (probably) or at the very least, the wash bottle will carve out a stream. The remaining water that has pooled at the bottom can be used to make wave-driven erosion with the craft sticks. If you decide to do this, instead of using an aquarium, you could use a shallow aluminum baking pan. You would have to reset the demo after each rotation, but it would be pretty easy—just gently tip the container to get the water out and make a new sand slope.)

Station 4: Provide a tray filled with sand and enough straws for each student group. At station #4 make a card sign that says: Be sure to wear your safety goggles. Then, gently blow air across the sand from one end to the other. Draw and write about your observations in your science journal.

As you monitor, ask questions of your students during the station rotations, such as: How do you think rainfall shapes the landscape? How might different angles of a slope in the downhill movement of water affect the rate of erosion? How might different soil types erode from the flowing of water at different rates? How might vegetation affect the movement of water over land surfaces?

Explain

Have students discuss in their groups what they observed at each station. Then, ask them to write a summary sentence in their science journal for each station. Summary statements may include: When water ran over the sand, it moved. Ask students how the changes in each station were similar and different. Ask them to offer an explanation for the changes.

Teacher's Note

Consider using the Tweet Up strategy when having students write a summary statement.

Have the class read, together or individually, Erosion by Virginia Castleman, or a similar book. If using the book Erosion read pages 4 through 7 and page 11. (Note: This is a great time to share with students that nonfiction books have the unique feature that the reader can enter the book at any point to get information.) Then ask students to write a group definition of water erosion using their own words and include two examples from the text and or the stations. Repeat with the definition of weathering, if students were able to observe the breakdown of rocks. (To add to students' understanding of weathering, you may want to have students rub two limestone rocks together to make a small sand pile to show how they easily are broken down. Another way to have students experience weathering, is to have students observe and draw the edges of a few pieces of small sandstone, then place them in a plastic bottle or tube with a lid and some water. Have students vigorously shake the tube for a few minutes, then remove the sandstones and dry them off. Have students draw the edges after the shaking. Edges should be smoother and students should be able to observe some sand particles in the plastic bottle or tube.) Student responses: Responses should include water erosion occurs when water flows over the ground or winds blows over the ground and takes other loose weathered material with it. The weathering is the natural break down of rocks into particles.

Next, have students watch the Bill Nye Erosion video clip.

Embedded video

https://youtube.com/watch?v=qGhf7jKXp6I

After watching the video about soil erosion, have your students add to their definitions and examples using the Examples and Non-Examples strategies. Ask questions such as: What did you find out about the changes of the earth's surfaces? What happened with the large block of mineral salt in the video? What do you think Bill Nye was trying to model when he froze the bottle of water? Bill Nye uses the word changing often in this video, what does changing have to do with erosion?

Bring back the card sort that was used as a formative assessment. Have students sort the cards into two groups: examples of erosion and non-examples of erosion. Have groups share their reasoning; don't forget to ask how they would describe the non-examples of erosion. Listen carefully and make note of any examples that may need further discussion and explanation. See Figure 4.

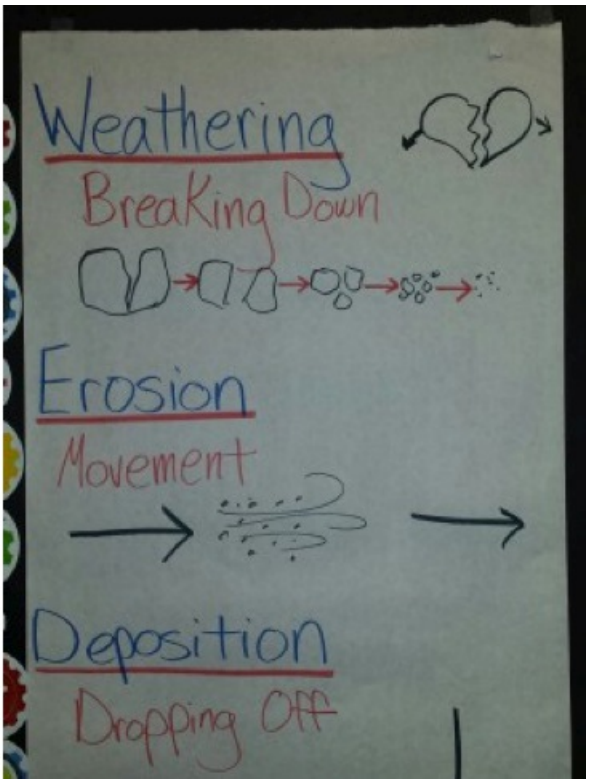

Figure 4. Describing Earth's processes.

Be sure to include the differences between the modeling activity that you have done in the classroom and how the processes of weathering and erosion happen over time across the earth's surfaces. Stress that while students observed the changes happening relatively quickly, the real processes of weathering and erosion take longer.

Extend

Ask students how they might investigate what type of soil erodes the most from water and wind conditions similar to those used in the Explore. Have students write a plan and conduct an investigation to test their hypothesis about which types of soil will erode faster.

Teacher's Note

NSTA defines Hypothesis as "an if-then statement of the expected outcome of an experiment; generalization based on what has been observed, rather than what one thinks should be observed; it implies a cause-effect relationship, not a guess."

Instead of using sand in the trays at the centers, have students collect clay-like soil, sandy loam, topsoil, or soil with vegetation and conduct the same experiments as they did in Explore to test their hypothesis. Have students discuss their findings (note: you might want to put a class chart on the board and have students share their results). Have them compare and contrast the rates of erosion for each type of soil. After students find out which type of soil erodes the fastest, they could observe areas of their school playground or an area near their school and make a prediction about which areas would erode faster during a big rainfall event.

Teacher's Note

To address the grade 5 OAS skill, have students research and propose plans to mitigate the anticipated soil erosion effects at their school. Then, write a note to the principal and custodian requesting how to limit soil erosion around their school. This could become an authentic project!

Teacher's Note

You might want also to invite a geologist from a local university or a County Extension Agent to come speak to your students about soil erosion. You may conclude with reading the book Grand Canyon, A Trail Through Time by Linda Vieira, then watching a video about the Grand Canyon. Also, since this lesson illustrates a negative aspect of erosion by asking students to design solutions to prevent erosion, it is important to include positive aspects, such as delta formation. Since elementary students often study the Mississippi and Nile River deltas and learn about the fertile farmland, this study could connect students' social studies curriculum to the science about weathering and erosion they are learning.)

Evaluate

Take students on a tour of the school grounds or an area near school and have them assess areas where they think erosion has or might occur**. For fourth grade students: Ask them to explain their reasoning and cite evidence for their claim. For fifth grade students, use a rubric to evaluate their plan and letter to the principal about the possible solutions to erosion on their school grounds or an area close to the school. If you have iPads available and the GPS function turned on, have students take pictures of the areas they observe. Have your class become a part of a network of citizen scientists by uploading the pictures to be shared.

Teacher's Note

The University of Oklahoma Earth Observation and Modeling Facility's Field Project uses GPS tagged photos of landscapes uploaded by everyday citizens, including students of all ages, to observe changes in the Earth's surface over time. In addition the full EOMF photo library is available and searchable for use in any setting including the classroom. You may want to explore the photo library and utilize images from different places around the globe over time to highlight the impact of erosion on Earth's surface. You may also download the EOMF Field Photo App for Android or iPad. See http://www.eomf.ou.edu/photos/ for instructions and help. Also, find more information in the attachments included.

Have students complete the following, I Used to Think, But Now I Know reflection (Keeley, 2016). This can be used to provide students a way to reflect on their learning and provide you with evidence of conceptual understanding. See Figure 5.

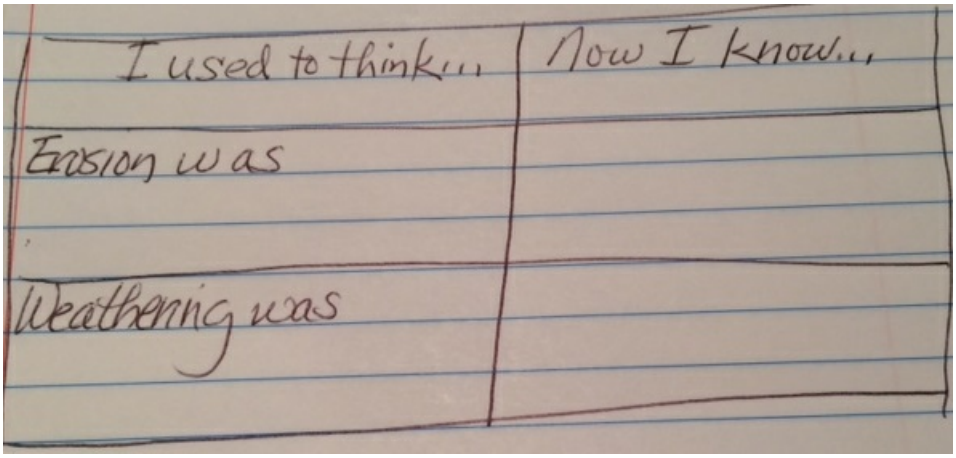

Figure 5. I Used to Think Strategy

Resources

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