

2nd Grade – Soil Erosion

Objective:

Through hand's-on experiments, students will learn how the shape of the earth's topography is effected by weathering and erosion.



ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-2)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)

ESS2.C: The Roles of Water in Earth's Surface Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

ESS2.D: Weather and Climate

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)
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Docent Lab Guidelines:

1. Docent(s) should plan to arrive early to set up before the class arrives.
2. Reserve the science room on the Science Lab Master Schedule. Please add 30 minutes of set up time and about 30 minutes of clean up time. Schedule at least an hour class or a little more if possible.
3. Safety glasses are not required. But aprons should be worn to protect clothes.
4. Give a brief 5-10 minute overview of weathering and erosion. You can also opt to play a short video instead of speaking. These are listed below.
5. There are two hands-on experiments and one demonstration. Docents can choose to either have the students rotate stations or have the entire class work on each experiment altogether.
6. Allow enough time at the end for students to wash up afterwards if needed. Girls can wash up in the adjacent girl's restroom.

7. The last 5-10 minutes of class, students can review their observations as a group.
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For Docent's Reference Only

During this session students will learn about the shape of our earth and how its shape continues to evolve. Our land masses and oceans look very different than they did 1,000 years ago. Even looking back at photos of our coast line just 60 years ago we can see a change. New islands are appearing, areas where there was once large sandy beaches are much smaller, glaciers are disappearing and even some the shape of mountains have changed. Discuss with the class how these changes occurred. Changes in our earth's shape occur due to weathering, erosion, earthquakes, volcanoes, fires, etc.... Our land forms continue to change. There will be two hands-on experiments. There is one demonstration which can be set up at the start of class and then observed at the end. If there are any very ambitious docents who would like to build the second (optional) demonstration, please contact your lead docent in advance and materials will be provided.

Weathering & Erosion from National Geographic

Weathering and erosion slowly chisel, polish, and buff Earth's rock into ever evolving works of art—and then wash the remains into the sea.

The processes are definitively independent, but not exclusive. **Weathering** is the mechanical and chemical hammer that breaks down and sculpts the rocks. **Erosion** transports the fragments away.

Working together they create and reveal marvels of nature from tumbling boulders high in the mountains to sandstone arches in the parched desert to polished cliffs braced against violent seas.

Water is nature's most versatile tool. For example, take rain on a frigid day. The water pools in cracks and crevices. Then, at night, the temperature drops and the water expands as it turns to ice, splitting the rock like a sledgehammer to a wedge. The next day, under the beating sun, the ice melts and trickles the cracked fragments away.

Repeated **swings in temperature** can also weaken and eventually fragment rock, which expands when hot and shrinks when cold. Such pulsing slowly turns stones in the arid desert to sand. Likewise, constant cycles from wet to dry will crumble clay.

Bits of sand are picked up and carried off by the **wind**, which can then blast the sides of nearby rocks, buffing and polishing them smooth. On the seashore, the action of waves chips away at cliffs and rakes the fragments back and forth into fine sand.

Plants and animals also take a heavy toll on Earth's hardened minerals. Lichens and mosses can squeeze into cracks and crevices, where they take root. As they grow, so do the cracks, eventually splitting into bits and pieces. Critters big and small trample, crush, and plow rocks as they scurry across the surface and burrow underground. Plants and animals also produce acids that mix with rainwater, a combination that eats away at rocks.

Rainwater also mixes with chemicals as it falls from the sky, forming an acidic concoction that dissolves rock. For example, acid rain dissolves limestone to form karst, a type of terrain filled with fissures, underground streams, and caves like the cenotes of Mexico's Yucatán Peninsula.

Back up on the mountains, snow and ice buildup into **glaciers** that weigh on the rocks beneath and slowly push them downhill under the force of gravity. Together with advancing ice, the rocks carve out a path as the glacier slumps down the mountain. When the glacier begins to melt, it deposits its cargo of soil and rock, transporting the rocky debris toward the sea. Every year, rivers deposit millions of tons of sediment into the oceans.

Without the erosive forces of water, wind, and ice, rock debris would simply pile up where it forms and obscure from view nature's weathered sculptures. Although erosion is a natural process, abusive land-use practices such as **deforestation** and **overgrazing** can expedite erosion and strip the land of soils needed for food to grow.

WHAT IS A GLACIER?

In a nutshell, a glacier is: *A solid river of ice.*

Glaciers are frozen rivers that move slowly downhill. They are found in places where it is always cold, like at the tops of very high mountains or in the Arctic regions.

As the snow falls on the top of one of these mountains, it builds up. The heavy top layers press down on the lower layers, which causes them to form ice.

This ice can be hundreds of feet thick. It slowly begins to move down the mountain and as it does, it picks up rock, clay, sand, and other debris from the mountain. The moving ice also develops dangerous cracks, called crevasses, which scientists can use to explore the composition and movement of the glacier.

As the glacier travels further down the mountain, it begins to melt and deposit the mountainous rubble it picked up earlier. The water from the melting glacier creates streams which feed the rivers in the area.

Many years ago there were far more glaciers on the Earth than we see today. We can see the evidence of these in the valleys they left behind.

These places will have a hollow where the glacier formed and began to move. This hollow is followed by a u-shaped valley that the glacier dug out as it moved down the mountain. Finally at the end of the valley, we will find a collection of rock, clay and sand, known as moraine that was left behind as the glacier melted.

Possible Videos to play for the class:

1. [Weathering and Erosion by Crash Course Kids](https://www.youtube.com/watch?v=R-lak3Wvh9c) (run time 4 mins. 9 sec.)
2. [Erosion by Bill Nye the Science Guy](https://www.youtube.com/watch?v=J-ULcVdeggE) (Run time 5 mins. 9 sec. but skip the first 1 min.)

3. "Glaciers with Chocolate" by MIT School of Engineering (run time 5 min. 52 sec.)
<https://www.youtube.com/watch?v=wK-SQD3fhrl>
4. Controlling Water Runoff (run time 5 min. 5 sec.)
<http://www.pbslearningmedia.org/resource/watsol.sci.ess.water.runoff/controlling-water-run-off/>

Group Demonstration #1: How Glacier Melting Effects the Coast

- **Estimated hands-on time for the docent: 10 minutes**
- **Estimated group discussion time: about 5 minutes at the start of class and about 5 minutes at the end of the class.**

Docents: Watch "Why Melting Glaciers Matters to the Coast" before the start of class. You will be recreating this same experiment for the students and talking about it. There is no need to show the students the video. This experiment will be set up before class starts. When the class arrives all you will need to do is add the ice cubes and leave it out on the countertop or outside while the students are doing their main experiment. Then at the end of class observe your finds and discuss what you learned.

<https://www.youtube.com/watch?v=IDZWWcAfn-c>

Materials:

- 2 clear plastic containers with high sides
- Water tinted blue with food coloring
- 2 large balls of clay
- Push pins
- Ice cubes
- Black Sharpie

Instructions:

1. Begin by placing one ball of clay in each container. Place in one end of the container and push it down and work with it to form a land mass with a sloping coast line. The opposite end of the container leave empty. This side represents the ocean.
2. Add the push pins to the land mass which represent houses, buildings and people.
3. Pour the blue water into the "ocean" side of both containers.
4. With a Sharpie mark the level of the water.
This is all prepared for you & is in the lab box. Please return this way
5. When the class arrives, start a discussion about glaciers. Ask the students to hypothesize what would happen if glaciers on our planet were to melt.
6. Next add the ice cubes. In one container add the ice cubes on top of the land mass. This represents the Glaciers. In the second container add the ice cubes to the ocean.
7. Set the two containers outside or near a window during the remainder of the lab session. 5-10 minutes before the end of class, observe what happened to the water level. Discuss how the sun has warmed the "glacier" thus creating more water being put into the "ocean." More ocean water causes land to now be underwater and some species having to relocate.

90% of solar radiation from snow & ice is reflected back out into space, but the rest is absorbed and causes melting. Once melted, the land or water below, which are darker in color, will absorb more solar radiation creating more heat in the atmosphere which then melts more snow & ice.

Group Demonstration #2 (optional): Landslide Experiment

If any docent is interested in putting this together before class and having it as a demonstration please let your Lead Docent know. It looks involved but fun.

- Do-it yourself landscape experiment
<https://www.youtube.com/watch?v=6tSnA9l6uL4>

Experiment #1: Edible Glacier (from Wacky World of Edible Science)

Estimated hands-on time: 10 minutes

Work in 2-3 table groups

Materials:

- 2 - 3 boxes of 6 oz. package of blue colored Jell-O (1 box per table group)
- 1 box of Oreo Cookies (1/2 box per table group)
- Sugar
- Water
- Cool Whip (1 per table group)
- Books
- Spoons
- Zip-lock bags
- Bowls (1 per table)

Preparation:

1. The day before class make the Jell-O as directed on package.
2. Pour into a 9" x 13" pan and store in the refrigerator until solid.
3. Set out the remaining materials on the tables for class.

Instructions:

1. Work in two table groups or three if you have enough docents.
2. Explain to the students that they will be making a glacier model and have them predict what will happen.
3. Hand each student a zip-lock bag with a cookie or two. Ask them to crumble the cookie into small pieces.
4. Next have them pour their cookie "rocks" into a bowl.
5. Mix with 1 container of cool whip.
6. Take the pan of Jell-O and prop up one side with a book or two to give it a sloping angle.
7. Have the students spread the ice (cool whip) & rock mixture (cookies) on the high end of the glacier (Jell-O).
8. Observe what happens.

A glacier is born!

The blueberry flavored gelatin is the icy blue center of the glacier. The Oreo Cookie and Cool Whip mix is the silty snow on top. Glaciers are made up of

fallen snow that, over many years, compresses into large, thickened ice masses. Glaciers form when snow remains in one location long enough to transform into ice. What makes glaciers unique is their ability to move. Due to sheer mass, glaciers flow like very slow rivers.

Experiment #2: Soil Erosion Experiment (from Life is a Garden)

Estimated hands-on time: 10-15 minutes

Work in groups of 4-6



Docents: Background information can be viewed on this video:

<https://www.youtube.com/watch?v=im4HVXMGI68>

Materials:

- Empty 2-liter soda bottle with the wrapper removed (six 2-liter bottles per group or three 2-liter bottles and three liter bottles)
- Plywood base (one per group)
- String
- Soil
- Compost
- Small plants
- Rocks
- Mulch (bark chips, leaves and sticks)
- Water
- Scissors and utility knife
- Black permanent marker
- Hot glue gun and glue sticks (to be used by the docents only)
- Hole punch
- Labels & markers
- Measuring cups
- Shovels or cups for scooping soil and compost
- Prepared 2-liter plastic bottle with established grass seedlings in it (optional)
- Rootvue display with established grass seedlings in it (optional)

Preparation:

1. Before the class arrives you may want to precut the large holes in the bottles. Or you can have the students draw the outline of the hole and then the docents can cut it during class time.
2. Set out several large containers of soil and a shovel or a cup for scooping.
3. Set out containers of mulch and rocks at each table.
4. Set out pitchers of water and measuring cups.
5. Preheat the hot glue gun and set up in an area where the docents can monitor it.

Instructions:

1. Prepare three of the soda bottles by cutting a rectangular hole roughly 3 in x 10 in (7cm x 25 cm) along the side of the bottle. You can use a marker to outline the piece you want to cut out.
2. **THE DOCENTS ONLY** will handle the hot glue gun and glue the bottles to the wood base making sure that the necks of the three bottles protrude a little over the edge of the board.
3. Label each bottle: Bottle 1, Bottle 2, and Bottle 3. The students can decorate the labels with markers.
4. Fill the first bottle with plain garden soil. Press down firmly to compact it in.
5. Fill the other two bottles with a mixture of soil and compost. Press down firmly to compact it in.
6. Leave the first bottle as it is.
7. For the second bottle cover the top soil with mulch. Some groups can cover their second bottle with small rocks instead of mulch so the two can be compared.
8. In the third bottle add the small plants. Press the plants down firmly to compact the soil.
9. Cut the remaining three bottles in half horizontally and keep the bottom halves.
10. Using the hole punch make two small holes opposite each other, nearest the cut side of the bottle.
11. Cut three pieces of string, roughly 10 inches long and tie each end of the string to the holes in the bottle. This will form a bucket to collect water.
12. Hang them over the neck of the three bottles on the board.
13. Slowly pour equal amounts of water into each bottle. Make sure the students use equal amounts of water. They can use the measuring cups to measure. Pour the water in at the end furthest from the neck of the bottle. Students are to take note of the color of the water collected in the buckets.
14. The water in the first bottle should be very dirty. The water in the second bottle and third bottles are much cleaner which shows that both mulch as well as root structure of plants assist in the preventing soil erosion.
15. The students can take these back to class and continue to water and monitor their experiment.

Take the experiment further by discussion with the students the effect to the environment when we cut down forests and clear out open planted areas for building purposes.

Clean-up tips:

1. Place left over soil and compost back in their original containers and leave for the next class.
2. Do not discard soil or compost down the sink. Please put in the trash.
3. Vacuum if needed. There is a vacuum in the lab.