Changing Earth's Surface

GRADE LEVELS:
Grades 6th – 8th

OBJECTIVES:

- Students will explore how landforms are created by unearthing the amazing world underneath our feet.

ACADEMIC CONTENT STANDARDS:

- Science: Earth Science: 8.13
- Science: Scientific Inquiry: 6.2, 6.3, 7.3, 7.4, 8.1
- Science: Scientific Ways of Knowing: 6.3, 6.4, 7.3

VOCABULARY/KEY WORDS:
Erosion- The process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.
Landform- A specific geomorphic feature on the surface of the earth, ranging from large-scale features such as plains, plateaus, and mountains to minor features such as hills, valleys, and alluvial fans.
Mineral- Any of a class of substances occurring in nature, usually comprising inorganic substances.
Permeability- *Geology*. The capability of a porous rock or sediment to permit the flow of fluids through its pore spaces.
Soil- The portion of the earth's surface consisting of disintegrated rock and humus.

EXTENSIONS AT COSI:
Ocean

- Visit the Erosion Table
- Visit the Wave Machine

ADDITIONAL RESOURCES:
http://www.geology.com/teacher
http://education.usgs.gov/common/primary.htm

http://adventuresinscience.edublogs.org/teacher-resources/
http://www.open2.net/sciencetechnologynature/worldaroundus/geologytooklit/rocktypes_embedded.html

SAMPLE TEST QUESTIONS:

Q. Soil is a mixture of:

A. Organic matter

B. Oxygen

C. Pieces of rocks

D. Water

E. All of the above

Q. Each layer of soil is called a:

A. Horizon

B. Litter

C. Organic Matter

D. Humus

Q. How does erosion affect topsoil?

A. Keeps it moist

B. Makes it more fertile, easier plant growth.

C. Washes it away

D. Moves the topsoil to other areas where it is needed more.

Q. Erosion is more common on _____.

A. Level Ground

B. Steep Slopes

C. In Valleys

D. On Small Hills

Changing Earth's Surface Pre Visit Activities

Identifying Erosion

Objective: Students will be able to identify erosion and explain the causes of erosion.

Materials:

- potted plant
- soil
- water
- rocks
- disposable aluminum pans
- container for water
- newspapers

Procedure:
Day 1--

Class demonstration (20 minutes):

1. Take a potted plant out of the pot, with soil intact. Discuss how the roots of the plant help to hold the soil in place. Ask what would happen if the plant was not in a pot, but in the ground and water keep running over it. Introduce the term erosion and discuss how wind, water, and ice can cause erosion. Ask students if and where they have ever seen the effects of erosion.
2. Explain that the class is going to go out to the playground to examine the effects of erosion on our playground and surrounding school property. Ask students to remember how plants hold soil and to pay special attention to the

placement of trees and shrubs on the school grounds. Students will be asked to take a pencil and notebook to write and draw evidence of erosion on the school property.

Outside activity (25 minutes):

1. As a class, point out evidence of erosion on the school grounds. Some good examples are often near drains, drain pipes, and at the edges of the blacktop.
2. Then have the students pair up with a partner to examine the rest of the area to look for other signs of erosion. Don't forget to set boundaries where students may explore.
3. When students find examples of erosion, they are to describe it in their journals and draw a labeled rough sketch of the erosion.

Closing discussion (15 minutes):

1. After students are back in the room, ask them to share what they have written in their journals about the effects of erosion on the playground and school property.
2. Ask if anyone noticed the placement of trees and shrubs. Ask the students if the trees and shrubs were placed in particular areas to help stop the effects of erosion.

Day 2--

Classroom review (10 minutes)

1. Review the term erosion and how plants help stop erosion.
2. Discuss the forms of erosion that were witnessed on the playground and school property. Explain that most of the erosion that was witnessed on the playground was caused by water.

Computer Activity (20 minutes):

1. Have students view the effects of wind, water, and ice on soil and rocks by going to these sites. Instruct students to read the information and view the pictures.
    - Wind Erosion - http://www.uwgb.edu/DutchS/EarthSC202Slides/WINDSLID.HTM
    - Water Erosion - http://science.nationalgeographic.com/science/photos/weathering-erosion-gallery/#baffin-island_832_600x450.jpg
    - Glacial Erosion http://science.nationalgeographic.com/science/photos/weathering-erosion-gallery/#bernard-glacier_835_600x450.jpg

Follow-Up/Extension Activity (20 minutes):

1. Provide each pair of students with a disposable aluminum baking tray, enough soil to fill the tray, water, small container, newspapers and some rocks. Cover each working area with newspapers.
2. Instruct students to fill their tray with soil, patting down to firm in place. Position rocks in the soil so that they cannot move about freely.
3. Place the narrow side of the tray filled with soil and rocks on a book, so as to place the tray on a slant.
4. Next have one of the students pour little drops of water, starting at the highest part of the tray, so the water can run down the soil.
5. Ask students to notice if any changes are taking place in their trays. See if the soil or rocks are moving out of position.
6. Direct the other student to pour larger amounts of water at the highest part of the tray. Again, ask the students to describe what changes are taking place in the tray. Are they seeing signs of erosion?

Soda Pop Cave

Description: Students will demonstrate how carbonic acid can slowly dissolve limestone and form caves.

Materials:
-A piece of limestone, preferably with an imbedded fossil
-Water
-Soda pop, preferably clear and sugar free

Procedure:
1. Show the class the example of limestone. Pass it around the room and allow each student to closely examine it. Review how limestone forms.
2. Ask the student how caves are formed in limestone. (Water dissolves the rock.) Pour water over the limestone. What happens? Do we have a cave? No, we have a wet rock! By itself, water cannot dissolve limestone. What else do we need?
3. From completing the "Make Carbonic Acid" activity, the students should remember that carbon dioxide in the soil could change the water into carbonic acid. What will happen when carbonic acid seeps through the soil and reaches the underlying bedrock? If this bedrock is limestone (or another carbonate rock), it will slowly dissolve it.
4. Ask the class where they might find carbonic acid in their every-day lives. Soda pop is acidic because it contains carbonated water, or carbonic acid.
5. Pour the soda pop over the limestone. Make sure that every student has a chance to see the limestone fizz and slowly dissolve. The soda will fizz on any material, but the acid will dissolve the rock. You could use hydrochloric acid in a demonstration, but if you do make sure the students follow all the safety procedures.
6. Discuss how carbonic acid can travel through the limestone (via cracks) and create cave passages.

Academic Content Standards:

- Science: Earth and Space Science: 4.8, 4.9, 4.10, 8.13

- Science: Life Science: 7.5

Giving Water the Treatment

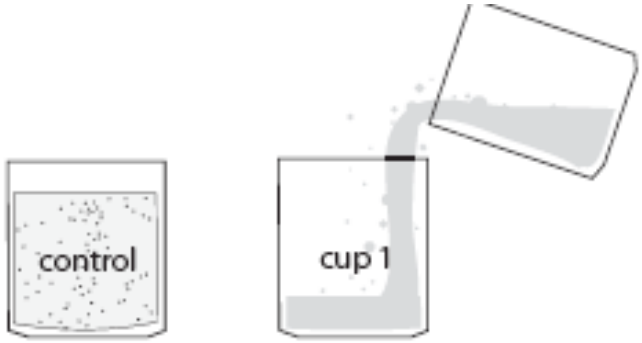
Objective: Participants will be able to filter contaminated water using a variety of materials.

Materials:

- Per Group:
  - Foam Cup
  - Clear Plastic Cups
  - Paper Towel
  - Alum (Available From Drugstore)
  - Yellow Food Coloring to Simulate Chlorine
  - Dirt
  - Control Cup
  - Access to Water
  - Sand
  - Gravel
  - Bowl

Procedures:

1. In a plastic cup, mix 5 mL dirt and then 200 mL of tap water. Stir well. Label cup 1.
2. Repeat step 1 with a second plastic cup. Label this cup "control" and set it aside.
3. Observe the mixtures and record your observations in your science journal.
4. Using an empty cup, aerate the water in cup 1 by pouring it back and forth into the empty cup several times to release trapped gases. See diagram 1.



5. Observe and record.
6. Add 2.5 mL alum to the water.
7. Let the mixture stand for 10–15 minutes. Observe and record.
8. To create a "filter," use a sharp pencil to poke ten small holes in the bottom of the foam cup.

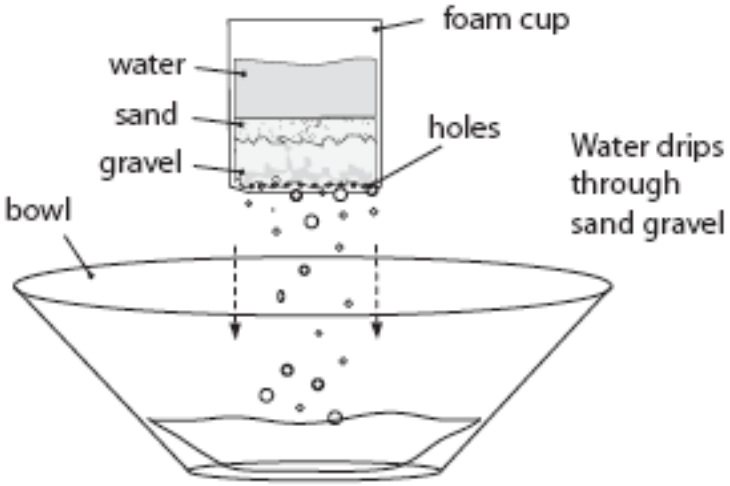


Diagram 2

9. Put a layer of gravel in the bottom of the foam cup.
10. Add a layer of sand on top of the gravel.
11. Hold the filter cup above a clean bowl.
12. Carefully pour the water from cup 1 into the filter cup, leaving behind the sediment at the bottom.
13. Observe what happens to the floc particles as they pass through the sand and gravel. Record your observations.
14. A small amount of disinfectant is added at this final stage to kill remaining bacteria and other microorganisms. Add 2 drops of food coloring to the water to represent this step.[1]

POSSIBLE INTERACTIVE QUESTIONS:

- What makes up a good filtering system? Can you make the best filter, using the materials provided?
- Why do we need water treatment plants?
- What is the purpose of adding the alum to the water?

1

- Why should chlorine be added to the water at the end of the process?
- What can you learn about the water cycle from this activity?

WHAT HAPPENED?

A water company goes through several steps to ensure safe and pure drinking water for the community. The water that has been processed typically goes through the following steps:

1. Aeration – water is sprayed into the air to release trapped gases and to absorb additional oxygen.
2. Coagulation – powdered alum is dissolved in the water, forming sticky
3. Particles called floc, which attach to suspended dirt particles in the water.
4. Sedimentation – the heavy particles of floc settle to the bottom of the tank, and the clear water above is skimmed from the top and sent on to the next step.
5. Filtration – as the clear water passes through layers of sand, gravel, and charcoal, small particles are removed.
6. Chlorination – a small amount of chlorine gas is added to kill any bacteria or microorganisms that may be in the water.

Academic Content Standards:

- Science, Physical Sciences, Nature of Matter 4.1, 4.2, 4.4, 6.2, 6.3, 6.4, 7.1

Changing Earth's Surface Post Visit Activities

The Ability of Permeability

Objective: Students will investigate how quickly water moves through various materials.

Materials:

- Per Group:
  - 2 Liter Bottle, cut in half equally
  - Sand
  - Topsoil
  - Gravel
  - Gauze
  - Rubber Band
  - Stopwatch
  - Coffee Filters
  - Beaker
  - Marker
  - Paper Towels

Instructions:

1. Place a piece of gauze over the spout of the bottle. (Cap should be removed.)
2. Use a rubber band to hold the gauze in place.
3. Measure 50 mL of water into a beaker and pour it into the bottom of the 2-L bottle.
4. On the outside of the bottle, use a marker to mark the level of water.
5. Empty the water out of the bottle.
6. Place the top of the bottle into the bottom. See diagram 1.
7. Observe the sand, gravel, and topsoil.
8. Predict which material will allow water to pass through the quickest and which one will be the slowest.
9. Measure 350 mL of gravel and pour it into the top of the bottle.

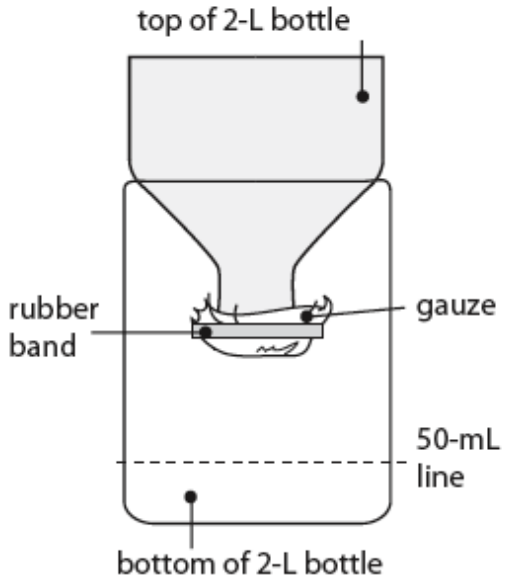


Diagram 1

10. Place a coffee filter on top of the gravel. See diagram 2.
11. Fill the beaker with 250 mL of water.
12. Set the stopwatch to begin timing when you start pouring the water into the bottle.
13. Quickly pour the water into the bottle, being careful not to splash the water out.
14. When the water level reaches the 50-mL mark, stop the stopwatch.
15. Empty the bottle of both water and gravel. Use a paper towel to clean the bottle for the next experiment.
16. Conduct two more trials for gravel by repeating steps 9–15.
17. Conduct three trials for sand by repeating steps 1 and 2 and steps 9–15.
18. Conduct three trials for topsoil by repeating steps 1 and 2 and steps 9–15.

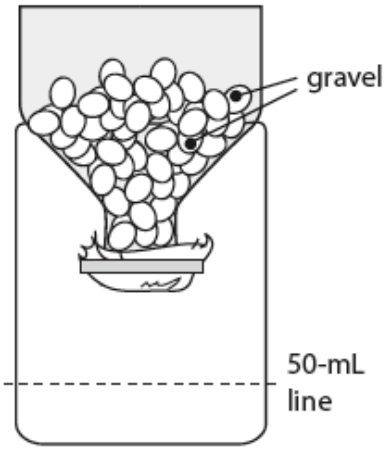


Diagram 2

Possible Interactive Questions:

- Compare all three of your trials for gravel. Did you have about the same time for each trial? Why or why not? How about the sand? Topsoil?
- Did other groups have similar times for each trial as your group did? Why or why not?
- Which material allowed the water to pass through the quickest? Why?
- Which material allowed the water to pass through the slowest? Why?
- Did your predictions match your outcomes? Why or why not?
- Which material is the most permeable?

Weathering and Erosion

Objective: Students will describe how weathering and erosion change the Earth's surface.

Materials:

- 15 rough, sandstone, limestone, or shale (sedimentary) rocks.
- Three same size containers with lids (such as 32-ounce Gatorade bottles, wide mouth).
- Three clear cups or jars.
- A pen, paper, and masking tape, to label both the cans and the clear jars with A, B and C.
  (Expand this activity by using an acid such as vinegar or lemon juice to show chemical erosion)

Procedure:

1. Separate the stones into three piles of five and put each pile onto a sheet of paper.
2. Label each can and jar "A," "B," and "C," and put five rocks in each.
3. Fill can "A " half way with water and put in the stones from pile "A." Do the same with pile "B," and with pile "C." Let the stones stand in the water overnight.
4. Pass the jar around to the students. Instruct them to hold can "A" in both hands and shake it hard about 10 times each, about 1,000 shakes.
5. Remove the stones from can "A" and pour the water into jar "A". Observe the stones and the water.
6. Using the same process, give can "B " about 300 shakes (you may rest between shakes). Remove the stones and pour water into can "B." Once again, observe the stones and the water.
7. Do not shake can "C." Remove the stones and pour the water into jar "C." Observe the stones and the water.

8. Compare the three piles of stones and the three jars of water. Ask the students: "How do the piles of stones differ?" " Can you explain why?" "Which pile acted as a control group? Why?" "How do the jars of water differ?" "How does this show what happens to rocks and stones through the water erosion process?"
9. Let the three jars of water sit overnight. Have the class observe any differences or changes.
10. Explain that we have just learned the process of weathering. Erosion continues the work that weathering starts. It helps loosen particles and transport-weathered material. Erosion by way of waves, wind, glaciers, gravity, running water, etc., causes change in geological features. Valleys, canyons, buttes, and drakes are all examples. The main agent of erosion is running water. It probably does more to wear away the land than all the other geologic agents combined. Ice, wind, plants and animals also affect landscape.

What is going on?:

Two forces, weathering and erosion, are constantly at work wearing away the rocks that make up Earth's crust. Weathering causes rocks to fragment, crack, crumble, or break down chemically. Erosion loosens and carries away the rock debris caused by weathering. Over time these two forces, working together, can change the shape of the land.