

Investigation Three - Weathering

Standard III

Students will understand the basic properties of rocks, the processes involved in the formation of soil, and the needs of plants provided by soil.

Objective 2

Explain how the processes of weathering and erosion change and move materials that become soil.

Intended Learning Outcomes

1. Use science process and thinking skills

Standard
III

Objective
2

Background Information

Soil forms over millions of years from parent material that is broken down by weathering from wind, water, temperature, chemical changes, and living organisms. Over time, glaciers move over the land and grind rocks together, rubbing off particles of all sizes. By day, rocks are warmed by the sun and expand, while at night the rocks cool and contract.

Over time, enough expansion and contraction cause rock particles to chip off. In cold temperatures water in the cracks of rocks freeze and expand, causing the rocks to break into smaller pieces. Plant roots will grow into "soft" rock and cause them to break. Water and wind wear away at rocks carrying tiny bits of rock along until they get trapped by soil.

Many rocks are broken apart by lichens. Lichens are tiny, crusty, coral-like plants (green, orange, gray, etc.) that live on rocks. These tiny plants secrete an acid that dissolves some minerals and breaks down the rock. Decaying plants and animals are organic matter. Organic matter is also acidic. When water and organic matter mix, they form a slightly acidic solution that breaks down rocks in soil. That is why soil in the eastern United States are more acidic than the soils in the west. They contain more organic matter.

Organic matter is good for plants. It keeps topsoil in its place, keeps soil particles together, retains soil moisture, and speeds up soil formation. It takes about 1000 years for just one inch of topsoil to form, depending on the type of rocks and climate.

Pre-Assessment/Invitation to Learn

Ask the students to consider these questions: Which is stronger, a plant or rock? Is water stronger than a rock? Would you expect water to damage or break apart large rocks?

Instructional Procedure

Students should draw diagrams illustrating each of the following types of weathering processes. Some of these will occur over a period of days or weeks. They should draw and label a series of diagrams to show the progression of weathering.

Activity 1 - Wind as an agent of weathering

1. Give groups of students a cup half-filled with salt and colored pieces of chalk. Have them take turns stirring the colored chalk through the salt.
2. Two things will happen: the salt will be colored and the chalk piece will wear away. Relate this to wind blowing sand on rocks and wearing them away like the formations seen in southern Utah. (Instead of wind blowing sand against Arches, tell them the chalk represents Arches and they are moving Arches through the sand.)

Materials

- 16 oz. paper cups
- Colored Chalk
- Salt

Activity 2 - Running water as an agent of weathering

1. Compare river rocks with sharp-edged rocks. Rub two pieces of sandstone together and notice the pile of sand that collects.
2. Fill the plastic bottle 3/4 full of water.
3. Drop in three to four small pieces of sandstone.
4. Make sure the top is screwed on tightly. Have students observe the clean, clear water, and the shape of the rocks.
5. Shake bottle vigorously for three minutes.
6. Examine the water. Take the stone out. Observe the weathering (rounded edges).

Materials

- Plastic bottle with lid
- Small pieces of sandstone (about 3 pieces per bottle)
- Water

Activity 3 - Plant growth as an agent of weathering

1. Explain that Plaster of Paris hardens and will represent rocks in this demonstration. Mix the Plaster of Paris quite well and pour into a disposable 16 oz. cup. "Plant" several bean seeds in the wet mix so that some are buried deep, some are just below the surface, and the others are about half submerged.
2. Assign a student to keep a wet folded paper towel on top of the cup. It must be moistened every day. (Soaking the seeds ahead of time will hasten their growth.)
3. Ask students to predict what will happen to the seeds. Record predictions and subsequent observations in their science log.
4. Over the course of two to three weeks you will see the seeds sprout. As they do, small fragments or flakes of the Plaster of Paris will break away. These flakes represent rock flakes broken away from large rocks as plants take root and grow on them.

Materials

- 16 oz. paper cups
- Bean seeds
- Plaster of Paris
- Paper towels

Activity 4 - Freezing water as an agent of weathering

1. Wet a chunk of clay (the soil kind) about the size of a grapefruit. Roll it into a ball.
2. Place the ball in a plastic bag and put it in the freezer. Leave it overnight.
3. The next day, remove the clay from the freezer. Its surface should be slightly cracked and broken. Ask students to record their observations.
4. Wet the clay again, taking care not to close up the cracks that have been formed. Put it back into the freezer for another night.
5. On the following day, take it out and have students observe what has happened to the cracks. Measure the cracks. You could repeat this process several more times, watching the cracks widen. Discuss how this relates to the breaking down of rocks on a larger scale. Compare this to autumn rains filling cracks in the rocks (and sidewalks) then freezing during the winter.

Materials

- Small plastic bags
- Clay (the soil kind)
- Water

Curriculum Extensions

Math-

- Measure the length of objects to the nearest 1/4 inch. (*Standard IV, Objective 2*)

Fine Arts-

- Use the different colored salts to make "sand" paintings. Gather baby food jars and pour layers of different colored salts to make colored "sand" jars. Fill completely and don't shake. (*Standard I, Objective 1*)

Science-

- Another way to show weathering by acid - Place a piece of limestone in a small jar. Cover with clear vinegar. Have students observe the "fizzing." Explain that the calcite in the limestone is reacting with the weak acid of the vinegar. Together they create carbon dioxide gas that is released through the bubbles. This action breaks down some rocks. For added interests, let the fizzing continue over night. Pour some of the spent vinegar into an evaporation dish (petri dish or flat lid). Let the liquid evaporate and look at the calcite crystals that form. Examine the limestone for pitting caused by the acid. (*ILOs 1, 3, 4*)

Assessment Suggestion

- Take a tour around the school grounds to look for evidence of weathering.
- Show pictures and categorize types of weathering illustrated.

Resources

Videos:

- Bill Nye Video, *Erosion*. The “*Rocks and Soil*” episode also has a very good segment on weathering.
- *Dirt: Secrets in the Soil*: The first segment after the introduction talks about how long it takes to form a layer of topsoil. After the words “Nitty-gritty,” there is a five-minute segment that specifically talks about how rocks are broken down by water, roots, and chemicals.

Websites:

- SURWEB www.surweb.org/ Go to Media Shows. Choose Earth + Physical Science. Choose Geology. There are several collections of images under “Weathering Forces.”

Homework & Family Connections

Find examples of weathering around the home and on trips. Make a photo album showing examples of all types of weathering.

Student Log

WEATHERING reshapes the Earth

Weathering means _____

Types of Weathering

Wind	
Running Water	
Plant Growth	
Freezing Water	

Name _____

What is Weathering?

Question: What is WEATHERING?

Which is stronger, wind or a rock? Your prediction: _____

Which is stronger, running water or rock? Your prediction: _____

Which is stronger, plant growth or rock? Your prediction: _____

Which is stronger, ice or rock? Your prediction: _____

Now you will test your predictions. Draw a diagram of each experiment.

Label the parts of your diagrams. Underneath each diagram write your procedure - what you did to test your hypothesis. Then record what the results were.

Wind as an agent of weathering:

Procedure: _____

Results: _____

Running Water as an agent of weathering:

Procedure: _____

Results: _____

Plant growth as an agent of weathering:

Procedure: _____

Results: _____

Freezing Water as an agent of weathering:

Procedure: _____

Results: _____
