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How do rocks break down into smaller pieces?

Teaching and Learning Focus

In the previous two investigations, students examined some of the physical properties of different types of rocks. They began classifying rocks according to their different characteristics. In this investigation, students think about how rocks change through time. They consider the breakdown of rock into smaller and smaller pieces through processes that collectively are known as **weathering**. The specific process that students examine in this investigation is **abrasion**, the action of rocks and sediment grinding against each other and wearing away exposed surfaces. In nature, abrasion occurs as wind and water rush over rocks, causing them to bump against one another and changing their shapes. Rocks become smoother as rough and jagged edges break off. Students run a model of this process by shaking sugar cubes and gravel together in a plastic container. The sugar cubes become smoother as their edges break off when they collide in the container.

Materials Needed

For each student:

- 2-3 sugar cubes
- 2-3 pieces of gravel
- small plastic container with a lid
- observation sheet
- magnifying glass
- paper (e.g. newsprint) to cover desktops

For instructional purposes:

• Images of Weathering, either as a printed sheet or on powerpoint slides

Safety

This investigation is generally considered safe to do with students. Do not provide glass containers to students because the shaking of the gravel could cause them to break. Students should be reminded not to eat the sugar cubes. Also, review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

Most probably, students recognize that in nature rocks exist in different sizes, from exposed mountain sides and plateaus to boulders to gravel to grains of sand. The processes by which rocks break down into smaller and smaller pieces, however, may be new to students. Begin the investigation by asking students about the various sizes of rocks they may have experienced or seen.

- 1. Describe the different sizes of rocks you examined in the previous investigations.
- 2. How big can rocks in nature get? What are some examples of big rocks? Where can they be found?
- 3. How small can rocks in nature get? Where are small rocks found?

Have your students discuss these questions, first in pairs, then groups and then as a whole class. Record their answers on a flipchart that you can refer to throughout the investigation.

Presenting the Investigation Question

After the scene is set, introduce your students to the investigation question: "How do rocks break down into smaller pieces?"

Have your students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on the flipchart. Have your students brainstorm ideas about how this investigation question could be investigated.

- 1. How would you design an experiment that could be used to test the investigation question?
- 2. What materials would be needed?
- 3. What would you have to do?
- 4. What would be measured?
- 5. How long would the experiment take?

Tell your students that they will be investigating this question and at the end of their study they will be able to provide reliable answers.

Assessing What Your Students Already Know

Students will probably have had some personal experiences of breaking rocks apart, such as by hitting a rock with a hammer or throwing a rock onto a hard surface. Some may be able to transfer this knowledge to a natural setting, such as rocks grinding against each other in a rockfall or landslide. Here are some initial questions that your students can discuss, in pairs, in groups, and as a whole class:

- 1. What happens when rocks smash into each other?
- 2. What might cause rocks to smash or grind against each other?
- 3. Do all rocks break apart in the same way?
- 4. Some rocks can have rough edges while others are quite smooth? What might create a smooth rock?

Have your students share their ideas with the class and record them as a list on the flipchart.

Have students think about what they would like to learn about the breakdown of rock into smaller and smaller pieces. Record their ideas on the flipchart as a list called "Questions we have about how rocks breakdown." This list will provide further insights into what your students know, and also what they would like to know. By the end of the investigation, some of these questions will probably be answered.

Exploring the Concept

- 1. Provide the materials to the students.
- 2. Instruct students to cover their desktops with paper.
- 3. Have students examine the sugar cubes with the magnifying glasses. Students should record their observations on the observation sheet provided. They can either draw or describe the sugar cubes.
 - Observation Sheet Word Document (26 KB) | Observation Sheet Adobe PDF (11 KB)
- 4. Ask students to place their sugar cubes in the small plastic container and to close the container with the lid.
- 5. Ask students to predict how the sugar cubes will change after they have been shaken inside the container for 1 minute. Students should record their predictions on the observation sheet.
- 6. Students shake the container with the sugar cubes inside for one minute.
- 7. Instruct students to open their containers and to poor the materials inside onto their desktops.
- 8. Students use their magnifying glasses to re-examine the sugar cubes. They should record their observations on the observation sheet.
- 9. Ask students to put the sugar cubes back into the container along with the gravel provided. Ask them to close the containers with the lids.
- 10. Ask students to predict how the sugar cubes will change after they have been shaken inside the container with the gravel for 1 minute. Students should record their predictions on the observation sheet.
- 11. Students shake the container a second time for 1 minute with the sugar cubes and gravel inside.
- 12. Students use their magnifying glasses to re-examine the sugar cubes. They should record their observations on the observation sheet.
- 13. Ask students to develop a conclusion about why the cubes changed as they did after each shaking.
- 14. Hold a class discussion about what the students observed. Ask students the following questions. Record their answers on the flipchart.
 - a. How did the sugar cubes change after the first shaking? What may have caused these changes?
 - b. Did the second shaking with the gravel cause the sugar cubes to look more worn? Why?

- c. Which shaking had more or less "crumbs"? Why?
- d. How did your predictions compare to your results.
- 15. Introduce to students the term **weathering**. Ask them the following questions:
 - a. What might cause rocks in nature to be shaken together much like how you shook the sugar cubes together with the gravel?
 - b. How long do you think this type of weathering takes? Why? [In nature, the abrasion of rocks is a process that takes place over a longer period of time. This activity is meant to simulate the abrasion process; therefore it is important for students to realize this difference.]

Applying Students' Understanding

Show the Images of Weathering pictures to your students. Have your students answer the following questions as related to the pictures:

- 1. Describe the surface of the rocks in each picture. Are the rocks smooth or rough?
- 2. What evidence would suggest that these rocks are weathering as a result of other rocks bouncing and grinding against them?

Images of Weathering Word Document (2.27 MB) | Images of Weathering Adobe PDF (637 KB)

You could also have students conduct another model of abrasion. But, instead of using sugar cubes, they use small pieces of broken limestone, all about the same size. They put the pieces into a plastic container filled with water. They shake the container for a total of 700 shakes. After each 100 shakes, they observe how the shapes of the rocks change. Have students predict how the rocks will change before they begin the activity to see if they are able to apply what they learned in the sugar cube activity to this new situation.

Revisiting Investigation Question 3

Complete this investigation by asking your students to reflect on this question and how their answers may have changed as a result of the investigation. For example, they should note that rocks breakdown into smaller and smaller pieces as they bounce, collide, and grind against each other. They also change shape, becoming rounder and more smooth.

Digging Deeper

The following passage provides more detailed information related to this investigation that you may choose to explain to your students.

Physical Weathering

Physical weathering, sometimes called mechanical weathering, includes all the processes which break rocks apart without changing their chemical composition. Following are examples of physical weathering processes.

Rock Abrasion

Rock abrasion occurs when rocks collide with one another or rub against one another. Collisions, if they are strong enough, can cause pieces of rock to break into two or more pieces, or cause small chips to be broken off a large piece. When two pieces of rock are rubbed together, the mineral grains in the rocks can be broken away from the rock surface. Rock abrasion occurs commonly in landslides where pieces of rock slide past one another as the mass moves downhill. It also occurs at the base of a glacier where pieces of rock that are frozen into the ice are dragged along beneath the glacier. In fast-moving streams and rivers, pieces of rock that are being moved by the flow rub against one another and against other pieces resting on the river bed.

Ice wedging

Ice wedging refers to the repeated freezing and melting of water within small cracks in rocks near the surface. The water in the cracks freezes as the temperature drops below freezing. As the water freezes, it expands. This expansion exerts tremendous pressure on the surrounding rock and acts like a wedge, making cracks wider. After repeated freezing and thawing of water, the rock breaks apart.

Plant roots

Plant roots can grow in cracks. As the plant grows, the root becomes larger. The pressure of a confined growing root can be substantial. These pressures make cracks in the rocks larger, and, as roots grow, they can break rocks apart.

Rocks Unit Sections

Introduction Comparing Rocks How Can You Tell Rocks Apart? **Rock Abrasion** Do Rocks Dissolve? Rivers and Land