A ROCKY TEST (1 HOUR)

Addresses NGSS
Level of Difficulty: 2
Grade Range: 6-8

OVERVIEW

In this activity, students explore the effects of physical and chemical weathering on various types of rocks. They use abrasive tools to model physical weathering and observe the effects of a weak acid to model chemical weathering's effects on rocks.

Topic: **Geology**

Real-World Science Topics:

- An exploration of the nature and composition of different rock types
- An exploration of the effects of physical and chemical weathering on rocks

Objective

Students will gain an understanding of rock types and their different responses to physical and chemical weathering.

Materials Needed for Student Activity

Materials Needed for Teacher Demonstration

- various types of rocks (granite, sandstone, slate, and limestone)
- plastic cups (enough for each type of rock)
- 1 L hydrochloric acid (0.1 M, or 10% diluted solution)
- graduated cylinder
- paper towels
- safety goggles
- rubber gloves
- apron
- access to a sink

Materials Needed for Each Group of Students

- 1/2 cup of rock chips of the various types of rocks: granite, sandstone, slate, limestone (note that chalk can be a representative sample of limestone; if using chalk, you must use pure chalk, not "dustless" chalk)
- abrasive tools (a file, sandpaper of various grades, emery board)
- paper towels
- access to a sink
- triple beam balance

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Teacher Preparation

Prepare a large rock collection, containing many different types of rocks. Five days before the activity, go through your rock collection and find two of each of the following types of rock: granite, slate, sandstone, and limestone. (Note: chalk can be used as a limestone rock sample because it contains calcium carbonate. If using chalk, be sure to use pure chalk and not "dustless chalk." Dustless chalk contains artificial sealants that will reduce the effect of the acid on the sample.) Each pair should be similar in size and shape. You can use a triple-beam balance to find pairs that have matching masses. From each pair, take one rock, and place it in a plastic cup filled with 60 mL of hydrochloric acid (HCl). Each rock should completely be covered by the acid. Be sure to take appropriate safety precautions when handling the acid, including using goggles, an apron, and rubber gloves. Let the rocks sit for five days in a safe spot. On the fifth day, remove each of the rocks from the acid, rinse, and allow them to dry fully before the start of the activity.

NGSS Three-Dimensions

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.	**ESS2.C: The role of Water in Earth's Surface Processes** • Water's movements, both on the land and underground, cause weathering and erosion, which change the land's surface features and create underground formations.	**Patterns** • Patterns in the natural world can be observed.

STEPS FOR *A ROCKY TEST*

1. **Warm-up Activity:** As a class, review or introduce the different rock types. Hold up samples of each type of rock and have students try to identify each. Prompt students to think about different things on Earth that are made of rocks (e.g. volcanoes, mountains, sidewalks, Earth's crust). Explain that there are three major groups of rocks: igneous, sedimentary, and metamorphic. Describe each rock type to the class, and use rock samples to demonstrate their physical characteristics. (See Background Information).

2. Next, discuss different ways that a rock can change.

   Ask students if they have ever looked rocks in a river. *How do these rocks feel?* (They are usually smooth.) Ask students if they can think of why river rocks would feel smooth. Explain that the water flowing over the rocks makes them break down through the processes of physical and chemical weathering. Physical weathering causes the rock to split or break down. Chemical weathering changes the minerals that make up the rock. Just as a nail will rust when exposed to moisture, minerals in rocks change when exposed to water, air, and chemicals in the environment.

3. Explain to students that they are going to build a rock garden outside. The goal is to have the rock garden last for a very long time, so before they make the garden, they will need to choose rocks that do not break down easily from physical or chemical weathering. Hold up several samples of rocks that students will use in this activity. Clearly identify them by rock type.

4. Test different rocks to see how they withstand being rubbed with abrasives to demonstrate their resistance to physical weathering.

   Divide students into groups of 2-3 and pass out a Student Handout to each group. Show students how to use an abrasive material (such as sandpaper) on one of the rocks. Explain that students will compare and contrast how much each of the rocks is affected by the abrasives. Have students rub each of the rocks with a different type of abrasive and write down their observations on the Student Handout. (Be sure that students use a different sample of each rock type for each abrasive. For example, students would need three granite rocks to observe the effects of the file, sandpaper, and emery board on granite).

STEPS FOR *A ROCKY TEST*

5. Next, tell students that they will look at the effects of chemical weathering on rocks. Take four new samples of granite, sandstone, slate, and limestone, and show them to students. Then explain that you have taken similar examples of each type of rock and soaked them in a bowl of acid for several days.

   Show students the "before" and "after" samples of each rock. Explain that the "before" rocks are similar in size and have approximately the same mass as the ones that were soaked in acid, so it is okay to use them for comparison. Have each student group take a pair of "before" and "after" rocks, and use a triple-beam balance to measure their masses and write them down on the Student Handout. They should also record any visible changes in the appearance of the rocks. Then, have groups switch rock pairs and measure again. Continue until all the groups have measured and recorded the "before" and "after" mass of each type of rock.

6. **Wrap-Up Activity:** Discuss the results of physical and chemical weathering on the rocks.

   Have students share their results. *Which rock types appear to resist physical and chemical weathering the most?* Note that the results will depend in part on the quality of the rock samples pro-vided. Most igneous rocks resist weathering better than metamorphic and sedimentary rocks. That said, very well consolidated and very poorly consolidated examples of all rock types exist. Based on these observations, have students decide on the best rocks to use for the rock garden, keeping in mind that they want the rock garden to last as long as possible. Then, have students choose a location outside and arrange the chosen rocks into a rock garden "cluster." Students can observe changes in the rock garden over the course of the school semester.

A Rocky Test Extension Activities

It takes a long time for most rocks to show the signs of weathering. Have students explore buildings and natural structures in their neighborhoods that show the signs of physical or chemical weathering. Students can take notes or draw pictures and share these observations with the class. Students may also want to use the Internet to find images that show how weathering breaks down ancient buildings and statues.

What are the main types of rocks on Earth?

Earth is composed of many different rock types. The three big groups of rock types are igneous, sedimentary, and metamorphic.

Igneous rocks result from the cooling of liquid rock. If the liquid rock cools below the surface of Earth, it forms a type of granite. Igneous rocks usually cool slowly. As a result, tiny crystals are often visible on the rock. However, when the liquid rock flows over the surface of Earth, the igneous rock formed is volcanic. Volcanic rocks cool so rapidly that crystals do not form.

Sedimentary rocks are made up of tiny pieces of rocks pushed together by heat, pressure, and chemicals. Sedimentary rocks are organized by the size of the grains within the rock. Sandstone is one type of sedimentary rock. It is fine-grained with particles that are about the size of a grain of sand. A conglomerate rock is made up of pieces of various sizes, from sand to pebbles or cobblestones.

The rock cycle continuously makes new rocks as old rocks are buried, melted, and then resurface. **Metamorphic** rocks are those that have changed from their original state (igneous, sedimentary, or another metamorphic rock), but have not completely melted to form new rock.

What is physical weathering?

Physical weathering is a process that breaks rocks down from large to small pieces. It can happen as a result of wind, gravity, water, ice, or other natural forces. Erosion is the process by which the weathered particles are carried away from their source. Other types of physical weathering might result from the freeze-thaw cycle. Water within a rock expands and contracts, causing the rock to crack. If a plant seed embeds itself in this crack, it may begin to grow. This will force the rock to split and allows more weathering to occur. You can often see this kind of weathering in sidewalks.

What is chemical weathering?

Chemical weathering occurs when water that contains chemicals washes over rock. Chemical reactions take place at the molecular level. The individual mineral grains within the rock react chemically with molecules in the water. Over time, the chemical makeup of the rock changes. Acid rain is a common source of chemical weathering.

Key Vocabulary

weathering: the change in the physical and chemical makeup of objects that is caused by natural forces

granite: an igneous rock formed as magma cools below the surface of Earth

sandstone: a sedimentary rock made of small pieces of other rocks that are pushed together

slate: a metamorphic rock formed from mud that is heated and squeezed together

limestone: a sedimentary rock usually formed in warm shallow seas from the shells of sea creatures; may contain fossils

A ROCKY TEST
TEACHER HANDOUT

Complete the following tables:

Physical Weathering of Rocks [Results may vary with quality of rock samples]

Rock Type	Did the file scratch the rock?	Did sandpaper scratch the rock?	Did emery board scratch the rock?
Granite			
Sandstone			
Slate			
Limestone			

Chemical Weathering of Rocks [Results may vary with quality of rock samples]

Rock Type	"Before" Mass	"After" Mass	Observations: Describe the appearance of the rock
Granite			
Sandstone			
Slate			
Limestone			

Which rock types did the rough materials scratch the most?
[Depending upon the exact nature of the rock samples used, the results may vary. In general, granite should resist scratches the most, although well-cemented sandstones and some slates may also resist physical weathering.]

Was there a change in mass and appearance of any rocks after they were exposed to the acid?
If so, which ones? [Answers will vary. The chalk (or limestone sample) should show the most change in mass and appearance due to the HCl.]

Which rocks best resisted both physical and chemical weathering? Which rocks will you use for your rock garden?
[Answer will vary.]

A ROCKY TEST
STUDENT HANDOUT

Name:

Date:

Physical Weathering of Rocks

Rock Type	Did the file scratch the rock?	Did sandpaper scratch the rock?	Did emery board scratch the rock?
Granite			
Sandstone			
Slate			
Limestone			

Chemical Weathering of Rocks

Rock Type	"Before" Mass	"After" Mass	Observations: Describe the appearance of the rock
Granite			
Sandstone			
Slate			
Limestone			

Which rock types did the rough materials scratch the most?

Was there a change in mass and appearance of any rocks after they were exposed to the acid? If so, which ones?

Which rocks best resisted both physical and chemical weathering? Which rocks will you use for your rock garden?