Weathering Rocks

Purpose

To model different kinds of weathering and compare how they change rocks.

Process Skills

Predict, observe, compare, collect data, interpret data, identify and control variables, draw conclusions, communicate

Materials
(per group)

Part 1:
- ❑ 5 pieces of chalk (similar size and shape)
- ❑ hand lens
- ❑ Data Sheet 1

Part 2:
- ❑ 5 paper plates
- ❑ clock or watch
- ❑ sandpaper
- ❑ plastic fork
- ❑ gloves
- ❑ vinegar
- ❑ 2 clear plastic cups (large enough to hold chalk)
- ❑ water
- ❑ freezer
- ❑ Data Sheet 2

Background

Rocks are hard, but they do break apart and change. **Weathering** is the breaking up or wearing down of rocks.

Weathering of rocks can happen in many different ways. When sand carried by the wind hits rocks, it can scrape and wear down the rocks. When animals—such as moles and groundhogs—dig in the ground, they push and scratch the soil. People dig in the ground, too. These activities can break up rocks. Acid in rainwater can change the material that makes up rocks and dissolve it. In addition, water can get inside tiny cracks in rocks. When the water freezes, it expands and makes the cracks bigger. Over time, this process can break rocks apart.

In this experiment, you will study the effects of different types of weathering on chalk. Chalk is a kind of rock called *limestone*.

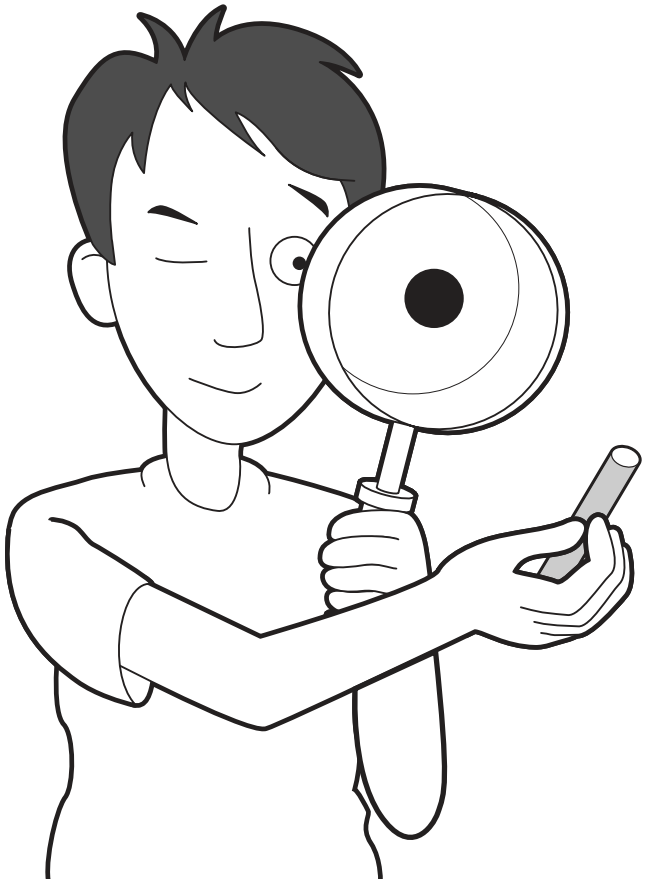
Time – Part 1: 10 minutes; Part 2: 30–45 minutes first day and 15 minutes second day (after freezing overnight)

Grouping – Pairs or small groups

Procedure

Part 1: Observing a Rock

1. As a group, choose one piece of chalk. Notice its color, shape, texture, and anything else you observe. On Data Sheet 1, draw a picture of the chalk. Then record your observations.
2. Use a hand lens to look closely at the chalk. On Data Sheet 1, draw a close-up picture of what you observe. Then describe and record what you see.



Part 2: Weathering the Rocks

Hypothesis: As a group, discuss the different kinds of weathering listed on Data Sheet 2 and how you think each of them can change rocks. Predict which kind of weathering will change the chalk the most and which will change it the least. Think of a reason for each prediction. Record your hypotheses on Data Sheet 2.

1. Set five paper plates on a table. Label the plates A, B, C, D, and E. Then place a piece of chalk on each plate.
2. Place the plate with Rock A where it will not be disturbed. Rock A represents a rock that is not affected by weathering. In science, this is called the *control*. This piece of chalk will stay the same so you can compare other pieces of chalk to it. Observe Rock A and record your observations on Data Sheet 2. You may rewrite your observations from Data Sheet 1.

Safety: Do not inhale chalk dust.

3. Use sandpaper to represent sand carried by wind or water. Gently rub Rock B with the sandpaper for 1 minute. Be sure to turn the chalk so that you rub different parts of it with the sandpaper. Observe the chalk and record your observations on Data Sheet 2.

Safety: Be careful when handling the sharp tips of the fork in the next activity. Aim the fork away from your body and stay far away from classmates.

4. Use a plastic fork to represent animal claws or human tools used to dig in the ground. Use the sharp tips of the fork to scratch Rock C for 1 minute. Be sure to turn the chalk so that you scratch different parts of it. Observe the chalk and record your observations on Data Sheet 2.

5. Place Rock D in a clear plastic cup. Put on gloves. Use vinegar, which is an acid, to represent the chemicals in air and water that cause weathering. Pour enough vinegar into the cup to cover the chalk. Leave the chalk in the vinegar for 5 minutes. While it soaks, look closely at the chalk. Also put your ear near the cup and listen carefully. Record your observations on Data Sheet 2. Be sure to put gloves back on before removing the chalk from the vinegar.

After 5 minutes, remove the chalk from the vinegar and place it on the paper plate to dry. Observe the chalk and record your observations on Data Sheet 2. Then throw away the wet chalk and plate, pour out the vinegar, and remove the gloves.

6. Place Rock E in a clear plastic cup. Use water to represent the water that can get into cracks in rocks. Pour enough water into the cup to cover the chalk. Leave the chalk in the water for about 5 minutes. Remove the chalk from the water and place it on the paper plate. Place the paper plate and wet chalk in a freezer right away and keep it there overnight.

7. Clean up all materials from Rocks A, B, C, and D. You will finish the activity tomorrow.

8. The next day, remove the paper plate with Rock E from the freezer. Place it in a dry place to thaw for about 5 minutes. Use the hand lens to observe the chalk. Record your observations on Data Sheet 2.

Name_____ Date_____

Part 1: Observing a Rock

Collect Data

Drawing of chalk, whole	Drawing of chalk, close-up

Observations of chalk

Name_____ Date_____

Part 2: Weathering the Rocks

Hypothesis:

The chalk that will change the *most* will be _____

because _____

_____.

The chalk that will change the *least* will be _____

because _____

_____.

Collect Data

Rock	Observations
Rock A: No weathering	
Rock B: Rubbed with sandpaper	
Rock C: Scratched with fork	
Rock D: Soaked in vinegar	
Rock E: Frozen and thawed	

Name_____ Date_____

Analyze Data

1. Which chalk changed the *most?* Why do you think this was so?

2. Which chalk changed the *least?* Why do you think this was so?

3. How did you decide which chalk changed the most and least? What did you look for?

4. What did you observe while the rock soaked in vinegar? Why do you think this was so?

Name_____ Date_____

Draw Conclusions

1. Based on the results of this activity, which kind of weathering do you think changes rocks the *most?* Explain your decision.

2. Freeze/thaw cycles happen at many times of the year. What do you think would happen if you were to freeze and thaw your chalk several more times?

3. What kinds of weathering helped to create the Grand Canyon?

Weathering Rocks

TEACHING TIPS

These process activities will help students understand the importance of minerals, rocks, and soil—the materials that make up most of the solid part of Earth. Students will learn about the properties of various minerals, rocks, and soils and how they are changed by weathering and erosion. They will come to recognize a connection between weathering and erosion of rocks and the formation of soil. Students will also explore the relationships between organic and inorganic elements of an ecosystem. Many plants and animals make their home in rocks and soil. Rocks, soil, and the materials contained within them represent vital resources that humans use and depend on for many applications. Understanding how rocks change and how soil forms may encourage students to help preserve these essential resources.

SET-UP AND PROCEDURES

- During Part 1, encourage students to thoroughly study the chalk and describe as many of its characteristics as they can.
- During Part 2, remind students to keep each piece of chalk with its original paper plate so they don't get the chalk pieces confused.
- Cover work surfaces with newspaper to catch any chalk dust generated. As students model each kind of weathering, have them work over the paper plate, which will catch any pieces of chalk that break off.
- See the *Unit Guide* or the *Nonfiction Books* for an explanation of the difference between weathering and erosion.
- If changes to the chalk caused by weathering are not readily visible to the naked eye, have students use the hand lens to make observations after weathering.
- Arrange access to a freezer that has enough space to store Rock E and its paper plate for all groups overnight.
- For Rock E, the chalk should be placed in the freezer immediately after soaking so that it does not have time to dry. You may wish to have students soak Rock E in water and place it in a freezer the day before they conduct the rest of the activity, allowing all of Part 2 to take place on the same day. Alternatively, prepare the frozen, soaked chalk ahead of time so students can complete the activity in one day.

SAFETY

- Explain to students that they should not inhale chalk dust or taste the vinegar. Have them wipe up any spills immediately.
- Remind students to use care when handling the sharp tips of the fork. Have them aim the fork away from their body and stay far away from their classmates.
- Have students wash their hands with soap and water after handling the chalk.

MATERIALS

- Provide each group with 5 new pieces of chalk of the same size, shape, and color. Thicker pieces of chalk may be easier for students to manipulate. Colored chalk may be used.
- Have paper towels available for wet and dry spills as needed.
- Instruct students on how to dispose of the vinegar. It can be poured down the sink or possibly saved for future science lab use by pouring it into a designated, labeled container.

EXTENSIONS AND VARIATIONS

- *Variation:* Instead of using chalk, have students make their own sedimentary rocks. Using the directions on a package of plaster of Paris, students can mix the plaster with water and add "sediments" such as sand, pencil shavings, or sunflower seed shells. Give each group a plastic ice cube tray and have them fill five sections of the tray to the same level to make five identical rocks. Let the plaster mixture dry completely for the time indicated on the package before removing the rocks from the trays.
- *Variation/Inquiry Science:* To explore the impact of weathering on real rocks, have students repeat this experiment using various rock types, such as sandstone, slate, granite, shale, marble, and pumice.
- *Inquiry Science:* Encourage students to test their responses to question 2 in Draw Conclusions by having them repeat freezing and thawing the chalk several times.
- *Inquiry Science:* Allow students to propose others types of weathering to model (and how to model them), such as weathering by plant growth, by rubbing rocks together, or by heating and cooling rocks. Use caution if students propose any type of chemical weathering or any mechanical weathering that may create flying bits of rock. Safety goggles are strongly recommended.

- *Research/Technology:* Have students use the library or online resources to research how various human creations, such as stone buildings or tombstones, have changed as a result of weathering. Cleopatra's Needle, a rock obelisk in New York's Central Park, is a good example.
- *Writing:* Ask students to write a persuasive essay on how they could build a bench out of limestone that would last for 500 years. Encourage them to think about the kinds of weathering they explored in this experiment and how they could build their bench to avoid weathering. For information on writing persuasive essays, visit Writing a-z.com.
- *Research:* See Using the Internet in the *Unit Guide* for suggested websites to extend the learning.

ANSWER KEY

EXPERIMENT Minerals, Rocks, and Soil—Weathering Rocks Data Sheet 1

Name_____ Date_____

Part 1: Observing a Rock

Collect Data

Drawing of chalk, whole	Drawing of chalk, close-up
Students should draw a whole piece of chalk unchanged by weathering.	*Students should draw a close-up of part of a piece of chalk, as viewed through a hand lens, unchanged by weathering. Depending on the strength of the hand lens, the texture of the grains may be evident.*

Observations of chalk
Students should list observations about a whole piece of chalk unchanged by weathering. Observations might include: • *Its color is white.* • *Its surface texture is smooth, but if broken, its interior is rough or jagged.* • *It is shaped like a cylinder with flat ends that have sharp edges.* • *If a ruler is available, students can add measurements to describe the chalk's size.* • *It is fragile if dropped or placed under pressure in certain directions.* • *It has a low hardness.* • *Its particles do not follow a clear pattern or are scattered.*

ANSWER KEY

Hypotheses and results will vary. Students should predict which rocks will be changed or weathered the most and least, and explain why they think so. Some observations will reflect little or no change compared to those on Data Sheet 1. Other observations might include how the chalk's appearance, texture, or other characteristics have changed. Examples are provided below.

EXPERIMENT **Minerals, Rocks, and Soil—Weathering Rocks Data Sheet 2**

Name_____ Date_____

Part 2: Weathering the Rocks

Hypothesis:

The chalk that will change the most will be *Rock C*

because *the fork will cause the whole piece of chalk to break apart*

_____.

The chalk that will change the least will be *Rock A*

because *it will not receive any weathering at all*

_____.

Collect Data

Rock	Observations
Rock A: No weathering	*The rock did not change.*
Rock B: Rubbed with sandpaper	*The chalk was rough and looked smaller. There was a lot of chalk dust on the paper plate. The top and bottom edges are not sharp anymore.*
Rock C: Scratched with fork	*The chalk had long grooves on it, and some small pieces fell off onto the paper plate.*
Rock D: Soaked in vinegar	*The vinegar broke down the chalk. It was covered with holes and was much smaller.*
Rock E: Frozen and thawed	*The rock did not change much. One small piece fell off, but that may have been because the chalk got bumped while it was in the freezer.*

ANSWER KEY AND EXPLANATIONS

Analyze Data

1. Which chalk changed the *most?* Why do you think this was so?

Results will vary. Students will most likely find that Rock B or C changed the most. They should infer that this kind of mechanical weathering can happen quickly enough to see a change within a short amount of time.

2. Which chalk changed the *least?* Why do you think this was so?

Results will vary. Students should find that Rock A, the control rock, did not change. It did not change because it was not exposed to any kind of weathering. Rock E may also not appear to change, and students may infer that repeated freezing and thawing is needed for weathering to be observed.

3. How did you decide which chalk changed the most and least? What did you look for?

Students may have compared the shape, size, and surface texture of each piece of chalk before and after weathering. They might also measure how much chalk broke off onto each plate after the weathering process.

4. What did you observe while the chalk soaked in vinegar? Why do you think this was so?

Students will likely observe bubbles forming and hear fizzing. When chalk is submerged in vinegar, a chemical reaction occurs. The bubbles and fizzing indicate the formation of a gas. The changes to Rock D model chemical weathering.

ANSWER KEY AND EXPLANATIONS

Draw Conclusions

1. Based on the results of this activity, which kind of weathering do you think changes rocks the *most?* Explain your decision.

Results will vary, but students' conclusions should be based on their observations. Assuming that Rock B or C changed the most, students will most likely conclude that sand carried by wind or animal/human activity changes rocks the most. Or they may conclude that chemical weathering can have a greater impact over a long period of time.

2. Freeze/thaw cycles happen many times per year in some areas. What do you think would happen if you were to freeze and thaw your chalk several more times?

Repeated freezing and thawing will most likely cause rocks to crack or change more. Each time water freezes in tiny cracks within rocks, the cracks widen due to expansion. Over time, cracks become so large that the rock breaks apart into smaller pieces.

3. What kinds of weathering do you think helped to create the Grand Canyon?

Students may suggest that all the kinds of weathering modeled in this activity helped to break apart the rocks and form the Grand Canyon. This famous geological landmark was formed over millions of years primarily through mechanical weathering, erosion, deposition, and sedimentation caused by the Colorado River. (What sets the Grand Canyon apart from other areas that have rivers running through them is the significant uplifting of the land—the Colorado Plateau—as the river cut through it. The layering of various rock types led to differential weathering and erosion in the canyon, resulting in features that have interesting shapes and colors.)