

Rocks: Clues to the Past

OBJECTIVES

Students explore some of the clues that rocks provide about the Earth's past.

The students

- ▶ compare different types of rocks
- ▶ model glacial scratches on rocks
- ▶ observe fossils in rocks and make a model fossil
- ▶ infer how rocks provide scientists with clues about the history and structure of the Earth

SCHEDULE

Session I About 50 minutes

Session II About 20 minutes, 1 day later

VOCABULARY

cast fossil
fossil
glacier
mineral
mold fossil

MATERIALS

For each student

- 1 Activity Sheet 3
- 1 pair safety goggles*

For each team of four

- 1 bag, plastic, reclosable, 9 cm × 20 cm
- 1 stick clay, modeling†
- 1 cup, paper, 8-oz

- 1 fossil item (pinecone, seashell, leaf, seed, or other organic object)*
- 1 knife, plastic
- 1 magnifier
- 1 spoon, plastic

For the class

- 2 bags fossils†
- newspaper*
- 1 roll paper towels*
- 1 bag plaster of paris†
- 2 bags rocks, gneiss†
- 2 bags rocks, granite†
- 4 bags rocks, sandstone†
- soap, liquid*
- water, tap*

*provided by the teacher

†in separate box

PREPARATION

Session I

- 1 Make a copy of Activity Sheet 3 for each student.
 - 2 Have each student bring to class an item to fossilize, such as a small pinecone, a seashell, a leaf, or a seed. Explain that the item must be organic (derived from a once-living organism).
 - 3 Set up four rock distribution stations. Place the samples of gneiss at one station, the granite samples at another, and the sandstone samples at each of the other two stations.
- Fill each paper cup three-quarters full with dry plaster of paris. Depending on the

4 abilities of your students, you may wish to mix the plaster of paris yourself during this activity. Follow general safety instructions on the plaster of paris package.

Set up a distribution station near a sink. Have liquid soap available.

5 Each team of four will need one magnifier, one plastic knife, one stick of clay, a sheet of newspaper, a paper towel, an item to fossilize, a paper cup

6 filled with dry plaster of paris, a plastic spoon, a reclosable plastic bag, and access to the liquid soap and tap water.

Session II

Each team will need the model fossil it made in Session I, plus several sheets of newspaper.

BACKGROUND INFORMATION

Scientists have learned a lot about the history and structure of the Earth by studying rocks. In this activity, students are introduced to some of the clues contained in rocks and the information these clues reveal about the Earth's past.

The first two clues are the type and the age of the rock. The crust is composed of three types of rocks: igneous, sedimentary, and metamorphic. **Igneous rocks** are formed by the cooling and crystallizing of magma.

Sedimentary rocks are formed from layers of sediment that are squeezed and cemented together under intense pressure.

Metamorphic rocks form when igneous, sedimentary, or other metamorphic rocks are changed by intense heat or pressure, deep inside the Earth.

By studying the **mineral** composition and age of rocks, scientists learn what conditions were like on Earth at the time the rocks were formed. For example, the

presence of pumice (a type of igneous rock formed from slow-cooling lava) at a particular location is evidence of volcanic activity in that region. The age of the pumice sample tells scientists when the eruption occurred.

A third clue provided by rocks is in the form of glacial striations (scratches) and deposits—unmistakable evidence of the presence of a **glacier**. A glacier is a huge, slow-moving mass of ice. Rocks and boulders become embedded in the ice. As the ice moves, the rocks scratch and polish the walls and floors of the valleys through which it flows. Grooves and striations are left behind. These markings indicate the glacier's direction of flow. When a glacier melts, these rocks, along with sand, clay, and smaller pebbles, are left behind. Similarities exist in the composition of piles of debris deposited along the path of a glacier.

The fourth clue that rocks provide are fossils. **Fossils** form when layers of sediment cover a dead organism and solidify around it. Traces of the organism are left behind in the resulting sedimentary rock. There are two types of fossils: **mold fossils** and **cast fossils**. A mold fossil is an imprint left in a rock after the remains of an organism have disintegrated. A cast fossil forms when a mold is filled in with minerals deposited by groundwater, creating a three-dimensional replica of the organism.

Fossils provide scientists with a tangible record of how life evolved on Earth—the types of plants and animals that existed, where they lived, and when they died. Fossils can reveal the age of the rocks in which they are found. They can also tell about geographic changes that have taken place over time. For example, the fossilized remains of shellfish found hundreds of kilometers inland indicate that the area had at one time been underwater.

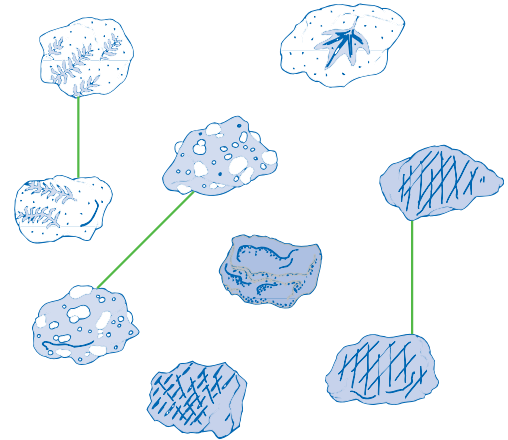
The purpose of this activity is to get students to think about rocks in terms of

the clues they provide about the Earth's past. In Activity 5, they will learn how these same clues are used to support the theory of continental drift.

▼ **Activity Sheet 3**

Rocks: Clues to the Past

You are a scientist. You have been asked to examine rock samples taken from two different sites. Draw a line between the samples you think may have come from the same place. Then tell what you think could have happened to separate the rocks.



Possible answer: The rocks that are similar may have been separated by glaciers, earthquakes, rock slides, or erosion. The markings, type of rock, and fossils are clues that the rocks may have come from the same place.

Guiding the Activity

Session 1

1 Tell students that scientists have learned a great deal about the history of the Earth from the clues provided by rocks. Ask students, **What do you think some of these clues might be?**

Tell students that in this activity they will find out what these clues are and what they tell scientists about the Earth's past.

2 Divide the class into teams of four and distribute a magnifier to each team. Have each team collect one rock from each of the four rock distribution stations. Tell students to compare the four rock samples their team has collected. Ask, **What can you tell about these rocks just by looking at them?**

Explain that scientists can test various rock samples to see if they are the same or not. Ask, **What do these tests reveal?**

Additional Information

Accept all reasonable answers.

Two of the four rocks appear to be the same type.

the type of rock

Guiding the Activity

Additional Information

Point out to students that they have just named the first clue. Write *type of rock* on the board. Tell students that rocks are made from various materials from the Earth called **minerals**. Write the word *mineral* on the board. Then tell students that rocks may form in several different ways. Explain that the type of rock is determined by three factors: 1) the way in which the rock was formed, 2) the type of minerals in the rock, and 3) the amount of each mineral in the rock. Two rocks that have the same amount and type of mineral and were formed in the same way will have a similar appearance.

- 3** Tell students that scientists can learn more about the formation of a rock by conducting additional tests on it. Ask, **What other information about rocks do you think scientists can find out?**

Tell students that scientists can also determine the age of rocks. Explain that by measuring the amounts of certain minerals in a rock sample, scientists can determine approximately when the rock was formed. Add the phrase *age of rock* to the list of clues on the board.

Have students return the rock samples to the distribution stations.

Accept all reasonable answers.

Make sure the rocks are returned to the correct stations.

- 4** Add the phrase *glacial deposits and scratches* to the list of clues on the board. Ask, **Does anyone know what a glacier is?**

Explain to students that a **glacier** is a huge, slow-moving sheet of ice. At various times in the Earth's past, glaciers covered vast areas of the Earth's surface.

Some students may have studied glaciers previously.

Guiding the Activity

Tell students that as a glacier advances, it picks up boulders, rocks, and pebbles of all sizes, which then become frozen in the glacier. Explain that as the ice continues to move through a valley, this debris scratches the rock walls or floor of the valley. Ask, **What might these scratches tell you about the path of the glacier?**

- 5** Tell students that they will make a model to demonstrate this. Give each team of four a plastic knife, a stick of clay, a reclosable plastic bag, a sheet of newspaper, and a paper towel. Tell students to place the clay on the newspaper. Have them pull the serrated edge of the knife along the surface of the clay, as shown in Figure 3-1.

Ask students, **In this model, what does the knife represent?**

Ask, **What does the clay represent?**

Ask, **What do the teeth on the knife represent?**

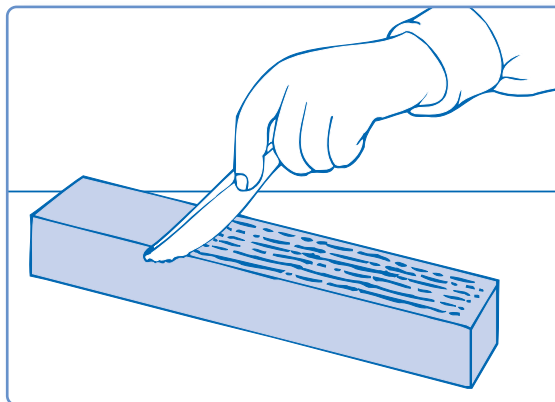
Have students examine the clay. Ask, **What do you see?**

- 6** Ask, **How do glacial scratches form on the surface of the Earth?**

Tell students that when a glacier melts, all the pebbles, rocks, and boulders fall to the ground in piles called glacial deposits. The rocks found in different piles from the same glacier will be similar.

Additional Information

The orientation of the scratches is a clue to the direction in which the glacier moved.



▲ *Figure 3-1. Simulating glacial scratches by pulling a knife across a stick of clay.*

a glacier

the Earth's crust

the pebbles, rocks, and boulders frozen in the glacier

parallel lines scratched into the smooth surface of the clay

Scratches are formed by the pebbles, rocks, and boulders frozen in the glacier as it moves through a valley.

Guiding the Activity

Have students wipe the clay from the knife with the paper towel and place the clay in the reclosable plastic bag. Both the knife and the clay should be returned to the kit for use in later activities.

- 7 Add the word *fossil* to the list of clues on the board. Ask, **What is a fossil?**

Tell students that a **fossil** is the remains or imprint of an organism that lived long ago. Give each team a fossil to examine. Have students pass the various fossils around the room so that each student has a chance to observe all of them.

Ask, **How are some fossils different from others?**

Write the terms *mold fossil* and *cast fossil* on the board. Explain that a **mold fossil** is an imprint of the original organism. A **cast fossil** is a mold that has been filled in with minerals that then harden into rock.

- 8 Tell students that they will make a model fossil. Give each team of four a paper cup filled with plaster of paris, a plastic spoon, and a paper towel. Have students write their team name on the cup.

Have the members of each team pool their fossil items and choose one to fossilize. Tell them to bring their fossil item and a paper towel to the sink/soap station and coat the object with liquid soap.

Instruct students to add water slowly to the plaster of paris, a little at a time, stirring constantly until the plaster is the consistency of pancake batter. Then have them place their fossil item gently on the surface of the plaster and press very lightly.

Additional Information

Accept reasonable answers.

Some are imprints or impressions in the rock. Others are three-dimensional, hardened-rock versions of the original organisms.

Safety Note: *Have students wear safety goggles when mixing and working with plaster of paris. Have them wash their hands afterward. Follow safety instructions on the plaster of paris package.*

You may want to oversee the selection of fossil items and arrange it so that each team chooses a different item to fossilize. For example, one team can use a seashell while another uses a chicken bone and so on.

Make sure students do not submerge the fossil item in the plaster.

Guiding the Activity

Have the teams set aside their cups to dry overnight. Tell students to throw away the newspaper and paper towels. Rinse and dry the plastic spoons. Return the spoons, magnifiers, and bags of fossils and rocks to the kit.

Session II

- 9 Give each team of four a sheet of newspaper to spread on a desk. Have students retrieve their cups. Instruct them to peel the paper cup off the hardened plaster and remove the fossil item. Ask, **What do you see in the surface of the plaster?**

Tell students that they have made a model of a mold fossil. Have students look at the fossils made by other teams. Ask, **Can you identify the objects from their fossils?**

- 10 To conclude, ask students, **What are four clues that can be found in rocks?**

Ask students to think about the importance of each clue. For each one, ask, **What do you think this clue tells scientists about the Earth's past?** Write student responses on the board next to the corresponding clue.

Give each student a copy of **Activity Sheet 3**. Tell them to use what they have learned about the clues contained in rocks to complete the sheet.

Additional Information

the imprint of the fossil item

Students should be able to do so.

type of rock, age of rock, glacial deposits and scratches, and fossils

The type and age of rocks reveal what conditions were like at a particular location when the rocks were formed. Glacial deposits indicate the presence of a glacier; glacial scratches indicate the direction of the glacier's movement. Fossils tell scientists about the kinds of organisms that lived in a certain area long ago.

REINFORCEMENT

Prepare several model fossils ahead of time. Challenge students to figure out what fossil items you used.

SCIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

CLEANUP

Have students discard the newspaper and paper cups, and fossil items. They may keep their model fossils if they wish.

SCIENCE AT HOME

Invite students to go on a rock hunt around their homes or at places their families like to visit. Challenge them to collect five different kinds of rocks. Have them bring their finds to class, and set aside space for a rock gallery. Students who have rock collections could bring in some of their unusual specimens. Encourage students to study the collection for clues about Earth's structure or history.

Connections

Science Challenge

Suggest that students start their own rock and mineral collections. Many Earth science textbooks and library books for youngsters include guidelines for collecting, identifying, classifying, and storing rock collections. If possible, arrange a class collecting trip to a nearby field, vacant lot, or road cut.

Science Extension

- ▶ Have students make fossil imprints as described in the basic activity. Explain that a fossil imprint is called a mold and that another type of fossil, a cast, may be created from a mold. To demonstrate this, have students cover the mold and the plaster just around it with petroleum jelly and pour fresh plaster into the mold so it overflows slightly. Tell them to tap the mold gently on the table to force air bubbles out of the plaster. When the plaster has hardened completely, students can lift out the cast. Explain that a fossil cast can form in nature when the original object decays and minerals fill the mold and harden, duplicating the object's form.
- ▶ Let students experiment with ice cubes as model glaciers, as follows. Elevate a metal cookie sheet by putting a book under one end. Place an ice cube at the elevated end, and observe and explain what happens. (The cube slides to the other end due to the force of gravity and the lubricating action of meltwater on the underside of the cube.) Next, lay the cookie sheet flat and sprinkle a small spoonful of sand over it. Elevate one end again, put a fresh cube at the elevated end, and observe and explain what happens. (The cube does not slide quickly to the other end of the sheet, but it does move slowly downward. Its speed will depend on the amount of sand sprinkled on the sheet.) Remove the cube and examine its underside. (Sand will be stuck to it.) Rub the underside on a sheet of clear

plastic in one direction (to represent the movement of a glacier), and observe the plastic's surface closely. (The sand grains on the cube will scratch its surface.)

Science and Health

Encourage students to research minerals that are essential to good health. (Major minerals include calcium, phosphorus, magnesium, potassium, sulfur, sodium, and chlorine. Trace minerals include iron, iodine, manganese, zinc, copper, and fluorine.) You may want to divide the class into teams and assign certain minerals to each team. Have students identify each mineral's dietary sources, its functions in the human body, and symptoms of deficiency. Help students organize the information in a class master chart.

Science and Social Studies

- ▶ Encourage students to find out about the Ice Ages that have recurred on Earth during its long history. When did various Ice Ages occur and what areas of the Earth did they cover? How did the Ice Ages affect plant and animal life on Earth? Did humans live during any of the Ice Ages? (yes) How might humans have been affected both by the changes in climate and by the climate's effect on plant and animal life? Help students plot various Ice Ages on a globe or world map.
- ▶ Ask students to research the names and locations of some prominent glaciers that exist today. Examples include Margerie Glacier and LaPerouse Glacier in Alaska, the continental glaciers that cover Greenland and Antarctica, and the Rhone Glacier in Switzerland. Help students plot the locations of these glaciers on a globe or world map and compare them with the locations of the huge ice sheets during the Ice Ages.