

Ice on the Rocks: A Glacier Shapes the Land

Overview

Students learn how glaciers, through abrasion, transportation, and deposition, change the surfaces over which they flow.



Title

Ice on the Rocks: A Glacier Shapes the Land

Investigative Question

What are glaciers and how did they change the landscape of Illinois?

Overview

Students learn how glaciers, through abrasion, transportation, and deposition, change the surfaces over which they flow.

Objective

Students conduct simulations and demonstrate what a glacier does and how it can change the landscape.

Materials

Introductory activity: an ice cube and a toothpick.

Part 1. For each group of five students: two plastic 1- or 2-qt. bowls; several small, irregularly shaped rocks or pebbles; a handful of coarse sand; a common, unglazed brick or a masonry brick (washed and cleaned); several flat paving stones (limestone); water; access to a freezer; cloth gloves; Student Page 1.

Part 2. For each group of five students: a square, deep (7-10 cm) tinfoil pan; quantity of white silica sand (Silica sand is round and produces better potholes; regular sand is less desirable but will serve.); 3 or 4 ice cubes; plastic wash tub and two backs (not necessary if the activity is done out-of-doors); nail for punching holes; salt.

Part 3. For each group of five students: a stack of at least ten magazines (*National Geographic* works well); a cup of flour.

For the Assessment Activity: Student Pages 2 and 3. For the Extension Activity: modeling materials.

Time

One and a half 50-minute class periods.

Advance Preparation

1. Place rocks and sand in each bowl and add 2.5 cm of water. Allow the sand to settle, and freeze the contents solid. Later, add water until the bowls are nearly full and again freeze solid. These are the "glaciers" for part 1.
2. Assemble the other materials. You may wish to do parts 1 and 3 in a laboratory setting or out-of-doors because these activities are likely to be messy.
3. Copy the student pages.

Introducing the Activity

Hold up a square, normal-sized ice cube. Next to it hold up a toothpick that is as tall as the cube is thick. Ask students to picture the tallest building in Chicago, the Sears Tower. If the toothpick represents the Sears Tower, the ice cube represents a glacier. The Sears Tower is about as tall as a glacier was thick! That was the Wisconsinan glacier that was over 400 meters thick and covered what is now the city of Chicago!

Procedure**Part 1**

1. Distribute copies of Student Page 1. Read and discuss this material together.
2. Divide students into groups of five. Gather together the materials needed for this activity; if possible, assemble out-of-doors.
3. Provide each group with one or two "glaciers." These can be removed from the bowls by dipping the bowls in warm water or by letting them sit briefly. Students who will activate the glaciers put on gloves, invert the blocks of ice so the rocks are down, and rub them back and forth across the bricks or flat rocks. They should press down very hard. Students should take turns doing this. Explain that they are essentially doing what a glacier does when it slides across the land, scouring as it goes. Have scratches appeared on the bricks and rocks? What can these scratches tell us?

4. Choose a place in the schoolyard that will not be disturbed. Lay all glaciers in a row, side-by-side, and let them melt. Later, return with the class and observe what has happened. What do you call the mound of debris that formed along the leading edge of the melting glacier?

Part 2

1. Maintain the same groups of five students and assemble out-of-doors. Distribute the materials and issue the following instructions: "Punch a number of very small holes in the bottom of your pan for water drainage. Then place the pan in the washtub and prop it up with bricks." If this activity is done outdoors, the pans may be placed directly on the ground without the need of a washtub.
2. "Mix a small quantity of salt with the silica sand and put a layer of this mixture about 1 cm deep on the bottom of your pan. Place three ice cubes, equally spaced, on the sand and cover them with the remaining sand. The ice cubes represent blocks of glacial ice that became detached from the main body of a glacier and were buried by glacial debris. Who knows why we added salt to the sand?" Students usually know that salt speeds up the melting process.
3. Leave the pans undisturbed until the cubes have melted. What happened to the surface of the sand? Are there any landforms in Illinois today that formed in this way? (Many such sites occur in northeastern Illinois. Volo Bog is a good example.)

Part 3

1. Maintain the same groups and remain outdoors for this demonstration of loess deposition. Review what loess is and from where it came.
2. Student groups divide their magazines into two stacks. The magazines should be stacked one on top of the other, but staggered to create a terraced slope. Position the magazines about 5 to 10 cm apart with both slopes slanting away from the center. One slope can be higher than the other. The slopes should simulate a river valley during glacial times (e.g., the Mississippi River).

3. Students deposit a cup of flour in the valley. Explain that this rock flour was ground by glaciers and deposited as outwash in the river valley.
4. Students gently fan or blow across the flour (usually from west to east as this was the direction of the prevailing winds) until the flour is redeposit-ed on the opposite slope.
5. Relying on the information in Student Page 1 explain what this experiment demonstrated.

Assessing the Activity

1. Distribute Student Pages 2 and 3; ask students to answer the questions on the sheet. Answers: 1. *end moraine*; 2. *kame*; 3. *kettle hole*; 4. *a kettle hole will form here*; 5. *glacial meltwater plunges into a crevasse in the ice and deposits its load of sediment*.
2. Ask students to design an experiment that shows abrasion, transportation, or deposition. Students may be more productive if they work in small groups. The experiments should be written in draft form and shared with the class. If you wish, the best experiments can be performed as an extension activity.

Extending the Activity

Using the drawing of the glacier (Student Page 3) as a guide, students construct a model of a glacier using styrofoam, plaster, and paint or other modeling materials. Relevant parts should be labeled.

State Goals

11,12

Concept

Glaciers changed the landscape through abrasion and through the transportation and deposition of rocks and soil.

Safety and Waste Disposal

Be sure students wear gloves to protect their hands when handling ice.

Student Page 1: Background Information

In the United States and in Illinois the landscape has been greatly affected by the rivers of ice that geologists call glaciers. Many of the most noticeable (Lake Michigan) and not-so-noticeable features of Illinois are the direct result of glaciers. Illinois has the distinction of being the state where glaciers reached their southernmost extent in North America. For our purposes, two glacial epochs are worthy of note: the Illinoian (300,000 to 125,000 years ago) and the Wisconsin (75,000 to 10,000 years ago). The Illinoian covered most of the state except for regions in the northwest, far west, and far south. The Wisconsin covered much of the north-central and eastern portions of the state.

Glaciers form and/or expand during periods of cold climate when extensive areas of ice and snow accumulate. As a glacier gets larger and the ice grows heavier, it moves outward and flows across the land. During warm periods, glaciers recede or melt back. An advancing glacier brings along materials (rocks, soil, sediments) frozen into its body. The materials that are located near the bottom act like sandpaper and smooth the surface of the bedrock or other surfaces over which the glacier passes. This abrasion can smooth the face of rocks, round hills, and scour valleys. In areas where bedrock comes in contact with the underside of a glacier, glacial striations are literally carved into the rock. These marks provide evidence that glaciers occurred in Illinois and give us the direction in which they traveled.

Glaciers knead and grind the landscape. This smearing, plastering, and pushing produces a sandy, gravelly, pebbly mud with the odd boulder thrown in. When glaciers melt, they dump whatever they are carrying with them on the land. These deposits may be granite boulders (erratics) brought from Canada, quantities of sand and gravel (glacial till) that became frozen into the glacier over time and also came along, and quantities of finely ground rocks (rock flour) that were deposited in valleys by melting glaciers. When the wind picks up rock flour, blows it around, and deposits it elsewhere, it is called loess. Loess is one of the primary building blocks of Illinois soils. In some areas of Illinois, loess is over 16 m thick. Other landforms created by the action of glaciers are moraines, kames, and kettles. End moraines form where ice melts at the same rate it is advancing and deposits its till in a low ridge along the leading edge of the ice. A kame or conical hill forms as glacial meltwater plunges into a crevasse in the ice and deposits its load of sediment, much like pouring salt from a shaker onto a table. When the ice melts, the pile of sediment is left. Kettles are produced when material washing off a glacier (outwash—sand and gravel) surrounds and covers an isolated block of glacial ice. When the ice melts, the land sinks, leaving a bowl-shaped depression—a kettle hole.

Glaciers are much more complex than this brief overview suggests. For more information on glaciers in Illinois, consult your local library.

Student Page 2: A Continental Glacier Name

Answer these questions by referring to the diagram of a continental glacier on Student Page 3.

1. What glacial landform is A?
2. What glacial landform is B?
3. What glacial landform *is* C?
4. What is likely to happen at D?
5. How do kames form (E)?

Student Page 3: A Continental Glacier (continued)

