

CREEPING SHEETS OF ICE

Students pose their own theories about how river channels are created by recreating glacial activity using blocks of ice and gravel.

TEACHER NOTES FOR DISCUSSION

The day before the activity, fill a 13 x 9 x 2 pan half full with a mixture of water, sand, clay, and pea gravel (about a half cup of each solid and enough liquid to make a muddy mixture). Freeze it. Using an electric knife, cut it into five-1/2 x 2 x 2-inch blocks.

Explain scientific theory to the students and tell them that after they make some observations, they will write their own theory of how glaciers change the land. Separate the class into five work groups. Most of the activity will be completed in small groups; however, students should answer questions 11-15 independently.

RELATED STANDARDS AND BENCHMARKS

Science

Standard 1. Understands basic features of the Earth

- knows factors that can impact the Earth's climate

Standard 2. Understands basic Earth processes

- knows how landforms are created through a combination of constructive and destructive forces

Standard 14. Understands the nature of scientific knowledge

- understands that questioning, response to criticism, and open communication are integral to the process of science

Standard 15. Understands the nature of scientific inquiry

- understands the nature of scientific explanations
- knows that scientific inquiry includes evaluating results of scientific investigations, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists

Mathematics

Standard 6. Understands and applies basic and advanced concepts of statistics and data analysis

- uses data and statistical measures for a variety of purposes

Objectives

By the end of this activity, students should be able to:

- conduct a scientific investigation.
- observe glacial effects on the landscape.
- develop and explain their own glacial theory.
- understand and explain basic motion and force principles.

Time Considerations

Instructor preparation:
30 minutes

Student activity:
two classes

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UNDERSTAND YOUR MISSION

In this activity, you will observe a normal V-shaped valley and the effects of melting glaciers on the valley.

LEARN THE LINGO

ablation	wearing away, over time, of a glacier through melting and evaporation
epoch	an extended period of time, usually characterized by a distinctive development or by a memorable series of events
frost heaving	the lifting of rock to the surface by the expansion of freezing water
glacier	a thick mass of ice originating on land and resulting from the compaction and recrystallization of snow; it shows evidence of past and present movement
Holocene	the present time in geological terms, or post-Pleistocene, geologic epoch
hypothesis	an educated guess made in order to draw out and test its logical or empirical consequences
interglacial	a warm period between glacial epochs
moraine	a ridge of sediment deposited by the melting edge of a glacier
Pleistocene	the epoch of earliest humans 1.6 million years ago
placer	a deposit of rocks left behind by a melting glacier
sediment	material, such as rocks and sand, deposited by glaciers, water, or wind
stream table	a table set on a slant with a river or stream model made of natural materials allowing it to change as water is applied
theory	the analysis of a set of facts in their relation to one another

Gather Your Supplies

- desk lamp (heat source)
- frozen blocks
- large pan (13 x 9 x 2)
- ruler
- sand
- wooden block

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BACKGROUND

A glacier begins when winter snowfall exceeds summer melting. Newly fallen snow is about 80 percent air. Through some melting, evaporation, and re-freezing, the light, fluffy snow turns into small, round granules called firn. If the firn remains on the ground for about one year, it will reduce to 50 percent air. When additional snow, along with dust, volcanic ash, and other air-deposited substances layer on top, the firn is compressed and changes into solid ice. This glacial ice is denser—composed of less than 20 percent air.

As the ice sheet thickens, the force of gravity causes it to move. Ice moves by changing shape or by slipping and shifting along cracks in the ice sheets. Like water, ice seeks the lowest levels and flows downhill. The ground beneath the glacier weakens due to the downward pressure of the ice and constant water saturation. This ground breaks off and moves with the flow of ice, lifting through periods of re-freezing and melting.

Scientists believe that glaciers have had a big role in shaping much of North America, including the Mississippi River valley. They theorize that as the glaciers developed, they picked up and carried gravel and even huge boulders. These varying sizes of debris carved out valleys. As the glaciers melted, rivers flooded and eroded, and more rocks and soil were carried away. Do you think valleys, like the Mississippi River Valley, developed this way?

CHART A COURSE FOR EXPLORATION

Create a stream table by completely filling a large tote tray, jellyroll pan, or lasagna pan with sand.

- Using a corner of the wood block, create a V-shaped valley the length of the sand.
- Place the block under one end of the pan to create an approximate twenty-degree slant.
- Measure the width and depth of the valley.
- Place the ice block at the upper end of the valley.
- Place the lamp directly over the ice block.
- Turn on the lamp and allow the ice block to melt for ten minutes.
- Observe and record what happens.
- Measure the width and depth of the valley.
- Repeat the experiment two more times or compare results with two other groups of students.
- How far down the original valley did the glacier travel?
- What happened to the sediment embedded in the glacier?
- Explain what happened to the shape of the original valley due to the glacier.
- Research other valleys in your area or in pictures. Can you tell, just by looking at the shape of the valley whether or not flooding due to melting ice or snow reshaped it?

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DATA TABLE	WIDTH	DEPTH	OBSERVATIONS
PRE-GLACIAL VALLEY			
POST-GLACIAL VALLEY			
PRE-GLACIAL VALLEY			
POST-GLACIAL VALLEY			
PRE-GLACIAL VALLEY			
POST-GLACIAL VALLEY			

From your experience with artificial glaciers, write a short report giving your own theory of how glaciers reshaped the earth.

Go Beyond

1. Research how the climate today compares to the climate during the Ice Age (the Pleistocene glacial epoch).
2. Write your own theory explaining how glaciers changed the landscape. Include any applicable data and/or research.
3. In areas where glaciation has occurred, what is the connection between the oldest rock exposed at the surface and past glacial events?

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	EXPERT	PROFICIENT	NOVICE
CONTENT	<input type="checkbox"/> accurate <input type="checkbox"/> legible <input type="checkbox"/> includes background information on glacial formation and movement <input type="checkbox"/> uses actual examples of glacially formed valleys	<input type="checkbox"/> accurate <input type="checkbox"/> legible <input type="checkbox"/> includes background information on glacial formation and movement	<input type="checkbox"/> incomplete, lacks background information on glacial movement or formation
LOGICAL REASONING	<input type="checkbox"/> conclusions are logical and based on data/research from each experiment and all class groups	<input type="checkbox"/> conclusions are based on data/research from each experiment	<input type="checkbox"/> illogical conclusions

REFERENCES

Anderson, Wayne I. *Geology of Iowa*. Ames, Iowa: Iowa State University Press, 1983.

Erickson, Jon. *Glacial Geology: How Ice Shapes the Land*. New York: Facts on File, Inc., 1996.

Lutgens, Frederick K. and Edward J. Tarbuck. *Essentials of Geology, Sixth Edition*. Upper Saddle River, New Jersey: Prentice Hall, 1998.

Prior, Jean C. *Landforms of Iowa*. Iowa City, Iowa: University of Iowa Press, 1991.