

MONDAY MORNING SCIENCE BLAST

Flubber Glacier - Earth Science - Earth Processes

Glaciers are inexorable, creeping ice masses. As they move, glaciers carve mountain valleys, cover continents, redistribute rock and sediment from high places to low ones, and as one writer so eloquently put it, "Create landscapes that bulldozers can only dream about." Ten percent of our Earth's surface is covered by glaciers, and it is interesting to note that glaciers, along with pack ice, hold about 75% of Earth's fresh water supply, more than all the lakes and rivers, groundwater, and water in the atmosphere, combined! The seven largest glaciers in the world include Siachen Glacier, on the border of India and Pakistan; Australia's Heard Island Glacier; Hubbard Glacier, north of Yakutat, Alaska; the glaciers of Africa's Mt. Kilimanjaro; Perito Moreno Glacier at the southern tip of Argentina, in South America; and Iceland's Vatnajökull Glacier. The biggest is Lambert Glacier in Antarctica, whose ice mass has been measured at 320 miles (515 km) long and over 40 miles (64 km) wide. Lambert Glacier is located approximately 1,400 miles (2253 km) from the South Pole.

Does life exist on glaciers? Amazingly, there are several species of ice worms (Genus *Mesenchytraeus*), less than an inch long, that feed on the pollens, insects, minerals and bacteria that are blown on to the surface of glaciers by the wind!

A glacier moves, or flows, downhill due to the deformation of its ice and also gravity. Glacial ice behaves like an easily breaking solid until it gets thicker than about 160 feet (50 meters). Pressure on ice deeper than this causes what is known as plastic flow. Ice consists of stacked layers of molecules. The bonds between those layers are relatively weak; thus, when the stress of an overlying layer of ice exceeds what is known as the inter-layer binding strength, it moves faster than the layer below.

Among many other factors, the rate of a glacier's movement depends on the underlying slope. As the pressure toward the base of a glacier increases, the melting point of water decreases and the ice melts. The friction between ice and rock plus geothermal heat from the Earth's interior also contribute to melting. This type of movement is the most common in warm-based, or temperate glaciers. Geothermal heat's action becomes more important the thicker a glacier becomes. In this lab, using flubber (teacher prepared; see attached directions), your students will determine what factors affect how fast a glacier moves.

After making the necessary amount of flubber (see attached directions) and gathering the materials list, instruct your students to set up their piece of foam core so that it is raised 10 cm at one end with the other end taped to the desk. Now have them get a blob of flubber and form it into a brick about 10 cm x 15 cm, placing the flubber on the foam core board so that it is just behind the line marked on the board. Students are to place 5-7 hole punches on the leading edge of the Flubber Glacier and in the Data section draw a picture of the flubber showing the position of the dots. Have them allow their glaciers to move for 5 minutes and after 5 minutes draw another picture of the flubber showing the new position of the dots. Now they are to remove the dots from the flubber and discard them.

With the boards still raised at 10 cm, instruct your students to set their Flubber Glacier on the start line and start a stop watch, measuring how far the flubber moves every minute for 5 minutes and recording these distances in the data section. Have them repeat Step 5 with their boards at 15 cm high and 20 cm high. Finally, students are to cover their boards with plastic wrap and repeat Steps 5 and 6.

This activity provides an easily understood model of how glaciers move and the effect various factors such as slope and contact surface have on the speed of glacial movement. A fun though time-consuming extension would be to have your students use salt dough to make a landscape showing some of the features left behind by glaciers as they melt. This is also a great time to bring in the accelerated melting of glaciers world wide as evidence of global warming. There are great sets of sequenced pictures of glacial retreat available on NASA's Earth Observatory website.

Flubber Glacier

QUESTION: What factors affect how fast a glacier moves?

MATERIALS:

flubber	recloseable plastic bag
foam core board	scissors
hole punches	stopwatch
marker	toothpicks
metric ruler	

PROCEDURE:

1. Set up the foam core board so it is raised 10 cm at one end while the other end is taped to the desk.
2. Get a blob of flubber and form it into a brick about 10 cm x 15 cm. Place the flubber on the foam core board so that it is just behind the line marked on the board. Place 5-7 hole punches on the leading edge of the Flubber Glacier. In the Data section draw a picture of the flubber showing the position of the dots.
3. Allow the glacier to move for 5 minutes. After 5 minutes draw another picture of the flubber showing the new position of the dots.
4. Remove the dots from the flubber and discard them.
5. With the board still raised at 10 cm, set the Flubber Glacier on the start line and start the stop watch. Measure how far the flubber moves every minute for 5 minutes. Record the distances in the Data section.
6. Repeat Step 5 with the board at 15 cm high and 20 cm high.
7. Now cover the board with plastic wrap and repeat Steps 5 and 6.

DATA:

DOTS AT START	DOTS AFTER 5 MINUTES

DATA: (cont.)

HEIGHT/ COVERING	1 MINUTE	2 MINUTES	3 MINUTES	4 MINUTES	5 MINUTES
10 cm/ None					
15 cm/ None					
20 cm/ None					
10 cm/ plastic wrap					
15 cm/ plastic wrap					
20 cm/ plastic wrap					

QUESTIONS:

1. What is a glacier?
2. What are several features created by glaciers?
3. With reference to the dots of paper you placed on the flubber, which dot/s moved the most? Which moved the least?
4. How does a glacier move?
5. How does the surface under the glacier affect its movement?
6. How does slope affect the glacier's movement?
7. What effect does accelerated melting of glaciers have on sea level?

Directions for Making Flubber

Materials: (per batch - 1 batch for each student group):

Mixture 1: warm water - $\frac{3}{4}$ cup
Elmers Glue (white) - 1 cup
food coloring
mixing bowls - 2

Mixture 2: 2 tsp Borax
Warm water - $\frac{1}{2}$ cup

Procedure:

1. Stir **Mixture 1** together in the first bowl.
2. Stir **Mixture 2** together in the second bowl.
3. Make sure each mixture is mixed well.
4. Pour Mixture 1 into Mixture 2.
5. No need to stir, just reach in and pull out the glob of flubber.
6. Work it back and forth in your hands for about 2-3 minutes

NOTES:

When making flubber, use Elmer's white glue; it really does work best. Once flubber is made it can be used right away or it can be stored for several weeks in plastic tubs or recloseable plastic bags stored in a cool place.