

Title

Lab #8: Modeling Glacier Flow with Plaster

Questions

What controls the shape of a flowing glacier? What controls the speed of a flowing glacier? How do crevasses form? Where on a glacier do crevasses form? How deep are crevasses relative to the thickness of the glacier? Do crevasses form in patterns or randomly on a glacier?

Overview

Glacier ice flows as a plastic. When glaciers flow over terrain that allows the ice to flow under compressional force, crevasses are not formed. And when glaciers flow under extensional force, such as over a topographic high, the glacial ice is stretched and splits forming crevasses. This can be easily demonstrated by allowing plaster to flow down a plywood board. The flow of the plaster glacier is slow enough to watch crevasses form and the plaster eventually hardens allowing further investigation.

Grade Level

5th – 9th

Objectives

In this activity students will:

1. Observe the shape of flowing glaciers (plaster).
2. Experiment with the size, extent, and pattern of crevasses formed in flowing plaster.
3. Experiment with the relationship of slope angle and valley shape to the speed of glacier flow.

National Standards

Content Standard B: Physical Science

Properties and Changes of Properties in Matter

NH Standards

1a. Science as Inquiry: Students will demonstrate an increasing understanding of how the scientific enterprise operates.

2c. Science, Technology, and Inquiry: Students will demonstrate an increasing ability to analyze, synthesize, and communicate scientific information using technology.

Teacher Preparation

1. 10 pounds of plaster-of-paris for each group. The plaster can be very messy and is very caustic, so students with sensitive skin may want to wear gloves or not handle the plaster.
2. You may want to consider mixing and pouring the plaster inside on plastic tarps or out-of-doors on plastic tarps.

3. The plaster sets very quickly and the wooden forms should be completed before the plaster is mixed.

Materials

1. Plaster-of-Paris (10 lbs per group)
2. Plastic to cover working area
4. Water (5 gallons per group)
5. Five gallon buckets (bakery buckets) to mix plaster in
6. Eye protection
7. Gloves (optional)
8. 39" (100 centimeters) of 2" (5 centimeter) X 6" (15 centimeter) lumber

Time Frame

1 (50 minute) class period

TEACHING SEQUENCE

Engagement and Explanation

There are many films on the movement of glaciers which may provide background information before this lab exercise is initiated (see resource list).

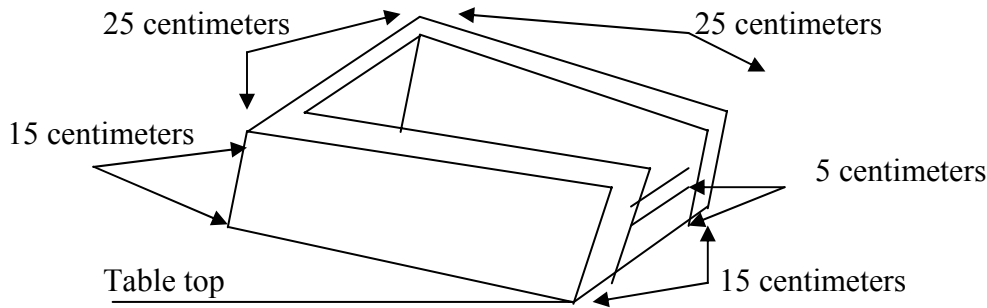


Figure 1: Wood form without plaster.

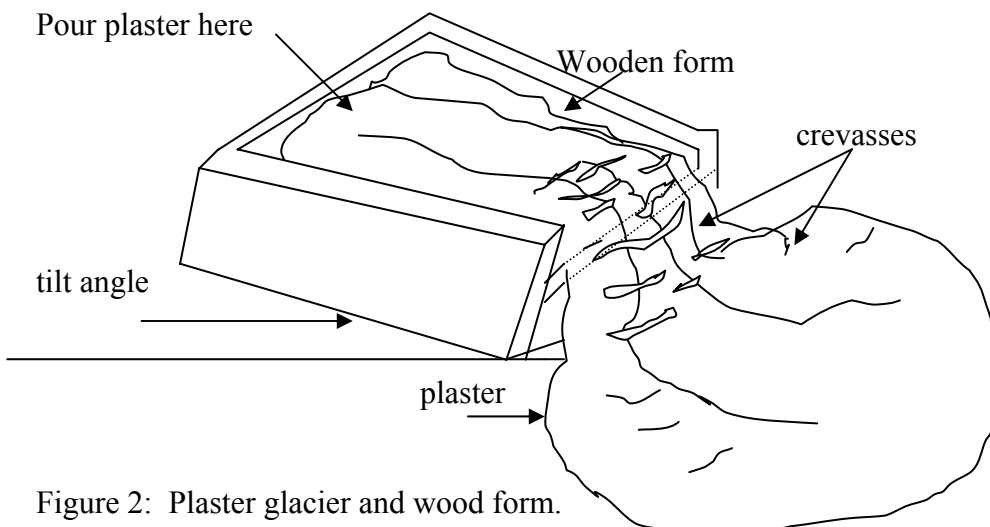


Figure 2: Plaster glacier and wood form.

(Teaching Sequence cont.)

1. Build wooden frame according to Figure 1.
2. Mix plaster
 - a. start with a container (5 gallon bucket) full of water.
 - b. slowly add the plaster as you continually mix the plaster and water
 - c. when the mixture becomes very viscous it is ready to be poured
3. Slowly pour the plaster mixture into the frame.
4. Pour only at the “back” of the frame – this simulates the accumulation of snow up-glacier and the subsequent “flow” of the glacier down hill.
5. Once an “appropriate” glacier has been formed, allow it to sit and harden.
6. Complete hardening may take a few hours or more.
7. Students can then identify glacier surface features, paint the plaster glacier, etc. to distinguish the different features.
8. Glacier features to look for:
 - c. Crevasses- splaying and longitudinal
 - d. Terminus
 - e. Ice fall section
 - f. Ojives
 - g. Shear zones

Elaboration

Students can experiment with different shaped wooden forms and different angles of the forms. They can also experiment with different mixing ratios of water and plaster-of-paris.

Exchange

Students can compare their data with other student groups and discuss the different types/speeds of movement of their plaster glaciers.

Evaluation-questions

1. What shape did the plaster-of-paris take as it flowed through and then out of the wooden form?
2. Did crevasses form in the plaster? Where? Why in those locations?
3. How deep are the crevasses relative to the depth of the plaster? Why?
4. Can the location of crevasses be changed by changing the shape of the wooden forms? How?
5. Under what conditions do crevasses always form? (hint: pulling/pushing)
6. What is the ratio of the depth of the plaster to the surface area of the plaster glaciers? Why?
7. Would it change the ratio of depth to surface area if you added more plaster-of-paris to the top of the still mobile plaster glacier?
8. If you consider the plaster poured at the top end of the plaster glacier to be snow accumulation, how long would it take a snowflake that lands at the top end of the glacier to flow to the bottom end of the glacier? How long might that translate into with real snow on real glaciers?

9. What happened to the stick that you placed in the flowing plaster glacier? Why?
10. What does this indicate about the speed of flow at the top of the glacier relative to the bottom of the glacier? Why would the top be faster or slower?

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Resources

Background

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Glossary

Crevasses: Cracks formed in glacial ice as the result of tensional forces pulling on portions of the glacier. Occurs often on the glacier's surface when a glacier overrides a topographic high.

Splaying Crevasses: Radiate out around terminus of glacier.

Longitudinal crevasses: Found between terminus and ice falls, spread across middle of glacier.

Ojives: Wave-like forms that are created down-glacier from ice falls where glacier is "backed" up as it continues flowing .

Ice Fall: Where the largest crevasses are formed on a glacier as the glacier flows down a large topographic high.