
Lab 1: Glacial Change: Develop a Model to Support the Data - Teacher

Our Changing Poles

7th-12th grade

Overview

Students test the hypothesis they formulated in the P.I.G. activity using 'glacier goo' as a model for polar glacial ice. They will test various ice conditions to examine the process and mechanism that can drive glacial change.

Objectives

Students will:

- Collect measurements on three different sets of conditions
- Identify the processes and mechanisms demonstrated in each
- Compare their lab results to real world glaciers

Activities

Students work in teams to complete the following activities and test their hypothesis:

- Glacier Review answer questions recalling what they have learned about glacial processes and mechanisms from *Glacier Basics Equations* and the evidence from P.I.G.
- Establish baseline condition for the experimental runs and then collect runs testing Ablation, Steady State and an Ice Shelf condition.
- Compare their results to *Glacier Basics Equations* or to P.I.G.
- Design their glacial run and report on the conditions they selected to test and their results tying it back to a real glacier

Supplies & Set up:

Each team or two or three lab partners will need:

- ½ Batch Glacier Goo
- Small rectangular container (we used plastic shoebox ~13" x 7-1/2" x 4-1/4" h)
- Section of matboard cut to fit **snuggly** in container to form a 'ramp'
- Laminated cm grid space graph paper (on webpage)
- Stop watch or timer & calculator (or smart phones)
- 6 inch ruler with centimeter measurements
- Optional supplies - plastic knife

Evaluation:

Students are able to complete the lab and use their results to describe real world glacial processes & mechanisms, relating them to changes being measured in the polar regions.

Materials

Batch of Glacier Goo:

Supplies Mixture #1:

3/4 cup warm water

1 cup Elmers white glue

Supplies Mixture #2:

1/2 cup warm water

2 tsp. Borax powder

General Supplies: Measuring cup, mixing bowl, wooden spoon, 1 qt. plastic zip lock bag. Note: Each mix supplies 2 lab teams with glacier goo. Goo can be reused and will store for a few months in zip lock bag.

Mix # 1: In large bowl add warm water to glue and stir until well mixed.

Mix # 2: Add 2 tsp. of Borax powder to 1/2 cup warm water and stir until the powder is dissolved.

Stir Mix 2 into Mix 1 and stir until a glob forms and most of the water is mixed in. This happens quickly! Knead and work the mix for 2 – 3 minutes until the water is incorporated into the mixture. Place the glacier goo in the zip lock bag. (Note: The mixture will store for a few months.)

Other Resources

Supporting Activities from website:

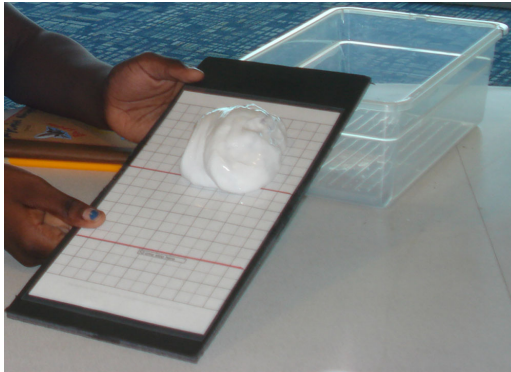
POLAR I.C.E.: *What is Happening to Antarctica's Pine Island Glacier*

P.I.G. Activity Background ppt

P.I.G. Fast Facts

Glacial Change: Develop a Model to Support the Data**LAB I: 'OBSERVATIONS': (For labs 2-4 students work in a team, work sheet for each student)****SAFETY: The materials for this lab are considered nonhazardous.****NOTE REGARDING SUPPLIES: For each team****Figure 1) Lab Supplies**

- ½ batch of 'Glacier Goo' should easily work for each group and is reusable for additional classes.
- Be sure the section of matboard is cut to fit **snuggly** in container to form a ramp/ice stream
- Laminate graph paper with cm squares and cut to cover matboard and secure it on with tape.
- You may wish to add other optional supplies for when students design their own experiment.
- Distribute lab set up to each group

SET UP: Done by the students.**Figure 2) Setting Up the lab**

- Set the matboard ramp in your container with one end resting on the upper rim and one end resting in the bottom creating a ramp for goo
- Be sure students have lab book for completing question responses. Responses should be done by each student

Glacier Review: The lab uses glacier goo as a model for polar glaciers. What glacial facts do you recall?

1. **Process:** Recall the glacier basics equations. What is needed for a glacier to maintain a steady size and surface elevation (height)? annual snow=annual melt
2. **Mechanism:** List at least one cause for a glacier to lose elevation. Melt from warming air or ocean water and/or Loss of ice shelf due causing glacier to move off land into the ocean
3. **Evidence:** Recall the elevation data you graphed for P.I.G. Is there evidence of change on Antarctica's P.I.G.? Write a hypothesis to explain what is occurring at P.I.G. Yes there is evidence of change in P.I.G. Sample Hypothesis: If a glacier has a small ice shelf then the glacier can move more ice off the land into the ocean because the ice shelf is not strong enough to hold back the ice.
4. **Compare:** Compare your hypotheses as a class. Next move on to test your hypothesis.

ACTIVITY: TEST YOUR HYPOTHESIS

1. **In nature glaciers move through their own weight and the forces of gravity.**
Mound your glacier (goo) on the top of the ramp. Release and describe the movement. The glacier goo flows down the ramp under its own weight
How is your glacier goo like a real glacier? Both the goo and a real glacier move by gravity
2. **Establishing Baseline:** Baseline is your starting point. Set aside 1/3 of your glacier goo for use in Run #2. To begin each run you will place the remaining goo at the top of the ramp so that the bottom or 'toe' lines up with the top 10 cm line on your graph paper. Collect an elevation (height)

measure by inserting your ruler into the glacier 1 cm above the toe and record elevation _____. This is how you collect 'baseline' and where you collect your test run measurements to assess change.

'Runs #1, 2, 3' start from baseline to test elevation changes with changing conditions. Each run is 2 minutes. Use the chart below to record your findings.

Note: Your teacher may want you to complete 3 of each run to calculate an average.

RUN #	TYPE	Baseline Elevation	Ending Elevation	Calculate Elevation Change	What <i>Glacier Basics Equation</i> explains this behavior?
1	Ablation				
	Average				
2	Steady State				
	Average				
3	Ice Shelf				How does this relate to Antarctica glaciers?
	Average				

- Ablation Run #1:** Collect 'baseline' measurement. Release your glacier (goo). Time and observe for 2 minutes then stop and hold to measure. Record findings. Complete this section of the chart.
- Steady Run #2:** Collect 'baseline' measurement. As the glacier flows add small bits of your remaining glacier (goo) to the glacier surface as 'new snow' every 20 seconds for 2 minutes. Measure and record your glacier and complete the chart. Compare elevation results in run #2 to run #1. _____
- Ice Shelf Run #3.** What if the ice shelf in front of your glacier were to melt from warming ocean water? Collect 'baseline' measurement. Place your ruler in front of the glacier as a shelf and hold it in place for 1 minute. Ice may flow over it but keep your shelf in place. After 1 minute remove your ice shelf (ruler) and observe 1 minute. Measure and record your glacier. Complete chart.
- Compare to Your Hypothesis:** Write a sentence explaining if the overall behavior of this model glacier supports your hypothesis. _____ **Answers will vary** _____
- Additional Data:** What other data would be useful to further test your hypothesis, or a revised or new hypothesis? _____ **Answers will vary** _____
- Match to the Real World:** Glacier goo is not the same as a real glacier but it can help us learn about real glaciers. Note 2 things you have learned about P.I.G. working with your own glacier model & be sure at least one mentions a connection to climate. **Answers will vary - possibilities include: ice shelves slow glacial flow; glaciers without new snow lose elevation; melting ice shelves allow glaciers behind them to accelerate.**
- Design your own run:** Design your own experiment using glacier goo. Describe the conditions and the results. Be sure to note how it relates to a real glacier. **Varied answers.**