Lab 2: Collecting Measurements: Compare Your Glacier to P.I.G.- Teacher

Our Changing Poles

7th-12th grade

Overview

Students use their glacier goo model to collect a series of measurements on elevation change and velocity. The model measurements are then compared to P.I.G., the real world glacier, in order to better understand scale.

Objectives

Students will:

- Collect measurements on elevation & velocity change in their model
- Calculate mathematical comparisons using dimensional analysis
- Compare their lab results to real world glaciers

Activities

Students work in teams to complete the following activities comparing their model results to the real world:

- Collect data on model runs - elevation and velocity using glacier goo.
- Calculate elevation and velocity data comparisons for P.I.G. using dimensional analysis
- Compare data from the model and the real world glacier.

Supplies:

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 graph paper with cm squares to cover matboard.
- Stop watch or timer & calculator
- 6 inch ruler with centimeter measurements

Evaluation:

Students are able to complete the lab, successfully completing the mathematical calculations. Students are able to use their results to ccompare their model to a real world glacier..

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

Name_____ Date_____

Glacial Change: How does your model glacier compare to Pine Island Glacier (P.I.G.)?

LAB II: 'COLLECTING MEASUREMENTS': (For labs 2-4 students work in a team with a work sheet for <u>each</u> student)

SAFETY: The materials for this lab are considered nonhazardous.
NOTE REGARDING SUPPLIES: For each team

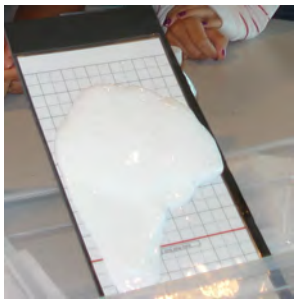

Figure 1) Glacier Goo

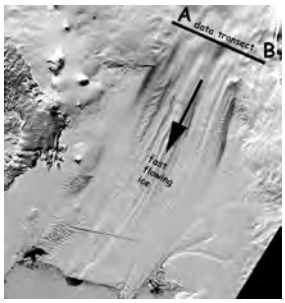

Figure 2) P.I.G.

See supplies & set up for LAB I and add:

- One wide strip of clear packing tape
- Permanent marking pen
- Copy of *Student Activity Table 2.*

Compare your 'model' glacier to Antarctica's P.I.G. In this lab you will collect measurements on the **elevation** and **velocity** of your glacier and compare your glacier measurements to P.I.G.!

Stop and Consider: Why do scientists studying Earth's glaciers measure **elevation** (height) and **velocity** (distance/unit time). What can these measurements tell them?

LAB 2 - ACTIVITY 1: RATE OF GLACIER ELEVATION CHANGE

1. **Basic experiment set up:** Set up your equipment with the matboard ramp in your container just as you did in **LAB 1**. Using glacier goo you will measure how long it takes your glacier to lose 1 cm of elevation and then record your data.

2. **Recall Baseline.** To begin each run place the goo at the top of the ramp with the bottom 'toe' lined up with the top 10 cm line on your graph paper. This is **baseline** position where each glacial run will begin.

Figure 3) Place clear tape on outside of container. Mark goo surface and 1 cm below.

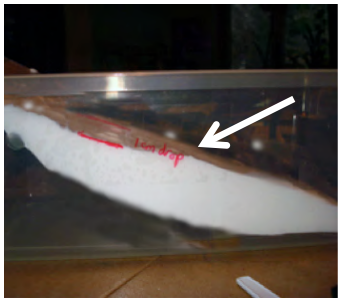

Figure 4) Watch glacier goo surface until it has dropped 1 cm.

Figure 5) Use a stop watch or phone to time the 1 cm elevation drop.

Name_____ Date_____

Lab 2 - Activity 1: Table 1

Column A	Column B	Column C
RUN #	**Time for elevation to drop 1 cm in secs.**	**Round to 1 cm/__min**
1		
2		
3		
Average		

3.

4. **Elevation Run:** Set up your equipment. Place goo at **baseline** position. **On the outside of the container** place a piece of the clear tape along the surface of the glacier, and use the permanent pen to mark a line along the surface and a line at 1 cm below the surface *(Figure 3).* Release the goo as you start the stopwatch. When the glacier drops to the 1 cm line marked on the container stop the watch.
   (Note – glacier goo can stick to the container wall if it spreads to the edge – use your plastic knife to carefully clear this so you can accurately time the 1 cm elevation change. Be careful not to push down on the surface and change the elevation!)
5. **Enter your data**: Record in seconds in **Column B** of the above chart.
6. **Column C - Convert to minutes:** convert seconds into nearest minute.
7. **Calculate Average:** Repeat procedure twice more. Calculate an average for 3 runs, or your teacher may have your class pool their results to calculate a class average. Place your answer in Column Table 3 second column.

Next you will compare your glacier elevation changes to P.I.G. How long did it take P.I.G. to lose 1 cm in elevation?

Lab 2 –Activity 1: Table 2

Column A	Column B	Column C	Column D	Column E
Location Recorded by KM #	**Table #2 Student Activity: record largest change (∆) ___meters/4 years**	**Record ___Meters /1 yr.**	**Record cms/1 yr.**	**1 cms/ ___ days**
#246	**20m/4 yrs.**	**5 m/yr**	500 cm/yr	**1cm/0.73 days**

8. Use the Nov. 2003 to Oct. 2007 data from **Student Activity Table 2** counting this as 4 years. Using the *Delta in Meters (∆) Nov. 2003 to Oct. 2007* column from the table find the location recording the largest elevation loss for the 4 yr. period. Record the identifying *Location Recorded by km #* from the **Student Activity** in Column A above. Record the total elevation loss in Column B. Remember this is in meters.

9. Calculate the meter loss for 1 year and enter it Column C. Then convert to m to cms.

10. To compare your data to P.I.G. convert the meters in Column C to cm and record in Column D. We want to look at the amount of loss by days so convert 1 year into days. I year =__**365**__days. To determine how long it takes P.I.G. to drop 1 cm divide total days by the number of cms.

Lab 2 – Activity 1: Table 3 – Compare Glacier Goo to P.I.G.

From Table 2: Column E (Item #8)	From Table 1: Column C (Item #6)
P.I.G. 1 cms/**0.73** _days	Glacier Goo 1cm/**your average**_mins.

11. **Consider Scale** - P.I.G. is dropping by cms/day while your glacier is dropping by cms/mins. How does your changing elevation compare to that of P.I.G.?
____Thinking of the sizes of the two systems (P.I.G. versus our experiment in a box) the two are much different in size and scope – but the student model is a representation that mimics what is going on with the glacier. The processes students explored are the same.

12. What if P.I.G. was made out of glacier goo, how would that affect its elevation loss?
Assuming the glacier goo is flowing faster than P.I.G. it would increase its elevation loss

13. To complete this activity we used the location of largest elevation change on P.I.G. How would the results differ if we used the area of least elevation change?
_The area of least elevation change was km #239 and it was zero so the glacier goo would have been moving a LOT faster than P.I.G.

Name_____ Date_____

LAB 2 - ACTIVITY 2: RATE OF GLACIER VELOCITY

Velocity: Next you will measure the velocity (rate of flow) of your glacier to compare to P.I.G. In its fastest flowing sections P.I.G. has been measured at **~3.5 km/yr or 9.6 m/day** (that is ~31ft/day!). Let's see what your glacier goo can do!

What is your Velocity? **Velocity = Distance/Time**

Your graph paper is marked to show 10 cms of distance. This will be your distance (D).

Lab 2 – Activity 2: Table 1 – Glacier Goo Run Times 10 cm distance

Run #1 - minutes	Run #2 - minutes	Run #3 - minutes	Average Run Time

1. **Velocity Run:** Return to baseline. Use your stopwatch to time the glacier flow on the 10 cm section on your grid. Start stopwatch as soon as you begin at baseline, stop when it first touches the line at the bottom of the marked 10 cm section. Record time below **rounding to the nearest minute**. Repeat twice more, or pool class results to get an average.
   (NOTE: If your goo is moving quickly you may wish to use seconds)
   Velocity (V = D/T) **V** = 10cm/_____min

2. **How does that compare to P.I.G.'s velocity**? We know how many meters P.I.G. can travel in a day so convert your glacier velocity into meters. This is easy to do since you measured 10 cms so multiply both sides of your equation by 10.

   V = 1meter/(#___ mins. X 10) OR _____minutes* (* insert this number wherever you see this symbol below)

   Your glacier needs * ____minutes to travel 1m

   So how far will it go in a day? There are 1440 minutes in a **day**. Divide by your minutes

   1440mins/*_____(your minutes starred above) to get _____m/day

   RESULTS

Glacier Goo V =____m/days	P.I.G. V = 9.6 m/day

   How does the velocity of your glacier goo compare to P.I.G.? __Each student glacier will vary

3. 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 but could include things like:
- A loss in elevation of a glacier means it is losing mass
- Antarctica has many ice shelves
- Ice Shelves help protect the glaciers from the warming ocean water
- As sections of the ice shelf of a glacier melt or break off the glacier accelerates
- Any of the glacier equations