Introduction to Inquiry Based Learning

Inquiry – An inquiry-based curriculum requires teachers to design experiences that engage students in scientific phenomena through direct observation, data gathering and analysis of evidence.

This course relies heavily on the inquiry method where you will discover through observations and self-directed experimentation. This can be both fun and frustrating at the same time. We will start out with guided inquiry where a few key questions will get you thinking and end the course with completely student lead inquiry.

Problem/Questions:

- How does a glacier form?
- In what ways does a glacier move?
- How much of an iceberg is below the waterline?

Learning Objective: To become familiar with the inquiry process

Procedure: (working in groups of four)

Glacier formation simulation-

1. You need a large graduated cylinder, 6 large marshmallows, and two masses.
2. Stack the marshmallows one on top of each other in the graduated cylinder.
3. Put the weights on top and let sit. After about ten minutes, make observations and complete the analysis section under "Glacier formation". Continue to the next section while waiting.

Glacier flow simulation-

In your group, each person will make one batch of flubber. The flubber will simulate the glacier and its motion via plastic flow.

1. In a small cup, mix 1 tbsp. of glue with 15 ml. of water. Stir with the craft stick until it is a smooth consistency.
2. Add 2 tsp. of the Borax solution (skim off the top) to the water-glue mixture. Stir quickly until it holds together than take out of the cup and knead in your hands until firm and dry.

Based on the demonstration or your pre-read of the instructions below, make predictions. Consider the following:

- *Will the glacier flow past the toothpicks or will the toothpicks move?*
- *Will the toothpicks/stakes tip over?*
- *Will the toothpicks move downslope at the same speed? (Stay in a straight line?)*
- *Will the toothpicks move faster along the sides or faster in the middle?*
- *Will the top of the glacier move at the same speed as the bottom? (Think of top and bottom as seen in a cross section.) What would be evidence for this?*

Draw a picture in the space below that shows how you think the flubber/glacier and toothpick will end up.

1. Prop one end of the PVC half pipe up 16 mm.
2. Combine the flubber from your entire group to make one big lump. Position your flubber at the top of the PVC pipe. Working quickly, insert 5 toothpicks in a row across the flubber in line with one of the marks on the pipe for reference. Make observations and complete the analysis section under "Glacier flow".

Iceberg simulation-

1. Fill a graduated cylinder with cold water about half way. It does not matter how much water you start with but it does matter that you know how much water you start with. Record your starting volume in ml. here (a)_____
2. Remove your "iceberg" from the canister and, working quickly, put into the water in the graduated cylinder. Record the new volume of the liquid water in ml. here (b)_____.
3. Use your pencil or pen to push the "iceberg" just until it is entirely submerged without submerging your pencil/pen. Record the volume of the liquid water again in ml. here (c)_____
4. To find the volume of the volume of the amount of the floating iceberg below the water line, subtract (a) from (b). Record here in ml. (d)_____
5. To find the volume of the entire iceberg subtract (a) from (c). Record here in ml. (e) _____
6. To find the percent of iceberg below the waterline divide (d) by (e) and convert to a percent. Record here _____

Clean up.
When complete, separate the back page and submit.

P. M. McNeal; Lab excerpts from http://beyondpenguins.ehe.osu.edu

Name_____

Date_____

Introduction to Inquiry Based Learning

Analysis

Glacier formation-

Consider the following questions:

Is there evidence that the marshmallows spread outward?

Is there evidence that the marshmallows stick together when compressed?

What would have happened if the sides of the graduated cylinder had not been there to hold the marshmallows in?

If the marshmallows had been snow, what form would they have assumed as a result of the pressure applied from above?

Write a short paragraph explaining how this activity illustrates the process by which glaciers are formed from snow. How is this activity different from actual glacier formation? Include your thoughts on snow accumulation versus how much snow melts during glacier formation.

Glacier flow-

Draw how the flubber and the toothpicks ended up below. Compare to your original drawing and record three conclusions. (Example: Glaciers flow uphill. I think this is due to a magnetic force found only at the poles.)

OVER

Icebergs-

1. According to your calculations from the simulation, what percent of total volume of an iceberg is below the water?_____
2. What property do you think accounts for the fact that the iceberg floats instead of sinks?_____
3. How would actual icebergs in the ocean be different than our simulation? What properties would differ?_____
4. Create your own experiment. How could we take this one step farther? Record your idea for the next experiment about floating icebergs. It should be in the form of a question:

Inquiry-based learning-

Write a paragraph that explains how this lab incorporated inquiry-based learning. Give examples that included inquiry- based learning along with examples that were not inquiry- based learning.

P. M. McNeal; Lab excerpts from http://beyondpenguins.ehe.osu.edu