POLAR TREC
Learning Resources

Details

Arctic / Antarctic
About one period
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High School and up

Introduction to Inquiry-based Learning and Glaciers

Overview

This lesson was designed to teach pre-service teachers an inquiry-based approach for a science classroom. To give context to the activity, I used my experiences as part of "High Arctic Change 2014" for a lab activity. As such, the activity focuses on discovering how glaciers are formed and flow and how icebergs float in water. The materials can be modified and used to illustrate a variety of topics from teaching students the nature of science to simply a lesson about glaciers.

Objectives

Understand inquiry-based learning as having the "potential to increase intellectual engagement and foster deep understanding through the development of a hands-on, minds-on and 'research-based disposition' towards teaching and learning". (Stephenson 2014) Be able to explain in your own words and provide examples and counter examples.

Lesson Preparation

Materials listed for preparation.

Procedure

If used in as a lesson in the inquiry approach, the components of the lesson are:

- A nine minute video to generate interest and introduce the concept of inquiry based learning
- A power point to review the inquiry approach and introduce basic glacier concepts
- A lab with three activities that investigate glacier formation, flow and how an iceberg floats
- Follow up reading assignment with three multiple-

Materials

- Video, Decomposition Lab found at: www.youtube.com/watch?v=hcuFmv5eH-k
- Power Point: Introduction to Inquiry Based Learning and glaciers
- Lab Activity Sheets (one for each student): Introduction to Inquiry Based Learning and glaciers
- Materials for the lab, listed below
- Student access to the article listed in Resources section.
- The homework questions are included/could be with online quiz

Lesson Preparation Materials

- some type of inclined planes with edges (PVC pipes split longitudinally work well)
- toothpicks
- school glue
- borax solution (1/4 C borax per 1 quart water)
- small cups
- measuring spoon sets
- craft sticks
- 20 ml graduated cylinders
- 250 ml graduated cylinders
- cylinders with blue frozen water
- 200 g brass weights
- marshmallows

choice questions to check for understand of inquiry-based learning methods.

Extension

- Choose a partner and a science misconception (ex: it is warmer in summer because that is when the Earth is closer to the sun)
- Conduct research in order to gain a correct scientific understanding of the topic.
- Collaborate with your partner to write a paper that states the misconception and gives a correct, scientific explanation.
- Design an inquiry based learning activity that you could use with elementary age students that engages them and provides an opportunity for discovery. This could be a hands-on activity. It could be students learning through playing a game or conducting their own research. Students could interview experts or put together a presentation or report. The main goal is to increase intellectual engagement and foster deep understanding through the development of a hands-on, minds-on learning environment.
- Give a ten-minute presentation, explaining the science behind the correct explanation of the phenomenon and demonstrating all/part of your inquiry activity.

Resources

Introduction to Inquiry Based Learning Website
http://www.teachinquiry.com/index/Introduction.html

Assessment

Assessment can be through evaluation of the writing sample at the end of the lab, answers to the questions that follow the reading homework or through evaluation of the report and presentation included in the extension activity.

Author / Credits

PolarTREC teacher, Peggy McNeal created this lesson based on her experience with High Arctic Change 2014. Peggy may be reached at peggy.mcneal@me.com. The lab activities are adapted from The Ohio State University, College of Education and Ecology, "Beyond Penguins and Polar Bears", licensed under a Creative Common License, http://creativecommons.org/licenses/by-sa/3.0/

Files Included

- Power Point, Introduction to Inquiry Based Learning and Glaciers
- Lab Activity: Introduction to Inquiry Based Learning and Glaciers
- Homework follow up questions to reading assignment

POLAR TREC Learning Resources

Standards

InTASC Model Core Teaching Standards:
Standard #4: Content Knowledge
The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make these aspects of the discipline accessible and meaningful for learners to assure mastery of the content.

- 4(c) The teacher engages learners in applying methods of inquiry and standards of evidence used in the discipline.
- 4(j) The teacher understands major concepts, assumptions, debates, processes of inquiry, and ways of knowing that are central to the discipline(s) s/he teaches.

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

Follow-up questions to reading homework assignment
Introduction to Inquiry-Based Learning

1. Which of the following best describes an inquiry-based approach?
A. Minimal guidance is provided by the teacher
B. Learning is equated with consuming knowledge or information
C. The process of learning is emphasized
D. Students learn isolated skills and knowledge

2. All of the following can be considered components of an inquiry approach except:
A. Students complete a project or presentation that demonstrates how the volume of an object is found
B. Students use flash cards to memorize multiplication facts
C. Students observe and record the stages of butterfly metamorphosis
D. Students develop a list of questions for an interview with a paleoclimatologist

3. How might metacognition be used with students?
A. Students review a graded test, make a list of what they missed, look for common mistakes and think of ways to prepare for the next test.
B. Students learn altered forms of verbs according to the rules of grammar
C. Students ferment and distill fruit juice with native wild yeasts
D. Students add sufficient layers of abstraction or complexity between events until all connection with the original is lost