POLAR TREC
Learning Resources

Details

Arctic / Antarctic
Less than 1 Period
Download, share, and remix
Elementary and Up

Elementary Polar Science Station

Overview

My high school has a Science Club whose members visit local elementary schools and run various "stations" that (elementary) students visit for 10-15 minutes before rotating to a different one. This lesson is designed to be one those – a quick hitting, but engaging look into polar science that will stir the kids' inherent curiosity and get them thinking about current events in science as well as the larger issue of climate change.

Materials

- Two 500 mL beakers
- water
- ice cubes
- hair dryer or heat gun
- plastic ramp (can be made from a lid or cut up milk jug)
- styrofoam cups
- pot holder
- blue food coloring
- smart phone
- light source (desk lamp or something of the sort)

Objectives

This lesson is purposefully built to be a quick, but effective introduction to polar science. They will see examples of science in the polar regions, learn how polar regions act as a "bellwether" for climate change, and how we may be affected by a changing climate.

Lesson Preparation

There is no prior learning either expected or required here.

1. Melting Ice: Prepare two (approximately 500 mL) beakers of water. One (beaker A) should be filled with water and ice such that the water level is just below the top of the beaker and the ice is floating. The second beaker (B) will be filled with water (only) to the just below the rim. A small, plastic ramp (cut out of a milk carton perhaps) angles downhill to beaker B so that any water placed on it will drain into the beaker. Ice cubes are placed on the ramp to simulate a land-based glacier.

2. The effect of CO2 on our planet: Repeat experiment

#1 this time make both beakers the same as beaker A (water with floating ice cube, water level near the brim). On top of beaker B place a pot holder that has been safety-pinned into a sort of teepee so that most, but not all, of the beaker's top is covered by the pot holder. [Instead of a pot hold you might be able to use a Styrofoam cup with a large hole cut out on one side. It may have to be taped or rubber banded to the beaker to hold it in place while hitting it with a hair dryer.]

3. Albedo: You will fill two tubs with water (they can as large as a dishwashing sized tub down to something around the size of a sandwich Tupperware. It is important that both containers are the same color – preferably clear.) Fill both with deep blue water (use food coloring) but place styrofoam icebergs (cup up some Styrofoam cups) in one of them.

Procedure

1. Ask students to predict what will happen to the level of water in beaker A once the ice melts. (Despite countless personal experiences with sodas and drinks with ice most students will not know what happens.) Ask them to predict the same thing for beaker B (most will probably guess this one correctly.) Use a heat gun or hair dryer to rapidly melt the ice in front of their eyes while observing the water levels.

   Results: The water level in beaker A will remain the same while the water level in beaker B will rise (and hopefully overflow).

   This experiment opens up the discussion for how melting polar ice (floating or not) will affect global sea levels. (Melting sea ice and ice shelves will not affect sea levels directly, but the melting of any land-based ice will.)

2. Ask students to predict which beaker will melt first when hit with warm air. Point a hair dryer toward each beaker (or use one with a wedge-shaped splitter that diverts the flow into two equal parts). The warm airflow should be directly toward the beakers in the same way, except in the case of B it should enter the opening of the teepee so warm air can get inside.

   Results: The ice in the insulated beaker will melt first since the insulation keeps more of the heat in.

   Discuss how this experiment mimics what is going on with the earth: Carbon dioxide helps keep our earth warm enough to be habitable. But we keep adding more of it into our atmosphere and this has the effect of keeping more of our heat in (which mostly comes from the sun). We are effectively adding more insulation to our biosphere – just as we did with the beaker.

3. Albedo: Shine equal amounts of light onto the two containers. Placing a single light

source in between the two tubs will work. Use the free Iphone app "Lux Meter" to measure the amount of light arriving at each tub to be sure they are essentially the same. Now use the same app to measure the reflected light coming off the two tubs (the meter should face downwards toward the tubs as if you were taking a picture of them).

Results: You should find that the reflected light is stronger off the Styrofoam "Ice flow" than the ice-free blue water. The measure of reflected light is called **albedo**. As the polar ice melts more dark blue water is exposed to sunlight. This in turn means that more energy is entering the water and warming it up. Which melts more sea ice. This is called a **positive feedback loop** and this process is occurring markedly in the Arctic Ocean.

Discuss how the positive feedback loop is affecting the sea ice extent in the Arctic and how that in turn will allow for a gradual warming of the Arctic Ocean. And that in turn can have profound consequences on global weather phenomenon.

Extensions

There are many follow up questions that could be asked of the students here. Depending on time and your particular situation you may have students tackle these questions in groups, have them answer some of them in their notebooks, or simply discuss some of them with a class out loud.

What is polar science?

Why is polar science so important right now?

Why are scientists studying the climate and its affects on the polar icecaps?

What is an ice cap?

Why are ice caps important to study?

How will melting ice affect humans?

How will melting ice affect animals?

Can humans affect climate? If so, how?

How could humans adapt to a warming climate?

How might animals adapt to a warming climate? (Choose specific species?)

Learning Resources

Resources

PolarTREC: www.polartrec.com
PolarTREC's website allows students to connect with teachers on polar expeditions. There, students can ask questions, follow particular expeditions, or investigate past expeditions. Teachers can access photographs and lesson ideas from a wide range of polar science topics. Like YouTube, it's easy to lose a lot of time in this website!

National Snow and Ice Data Center: http://nsidc.org/
As the name suggests this website is essentially the world's database for all data pertaining to snow and ice measurements (and there are tons!). The website has many links to research and current expeditions.

EPA Climate Change site: http://www.epa.gov/climatechange/
Excellent information accessible to many elementary grades right on the home page.

NASA's Climate Change site: http://climate.nasa.gov/
Cool photos, excellent summary of facts, what we can do, plus more articles for advanced students.

Lux Meter for iphones is a free app that can be obtained online.

Assessment

If doing this lesson with a class I would recommend students discuss some of the extension questions in small groups before presenting their answers to the class at large. Teachers could listen to proposed answers and guide students toward "correct answers" if need be.

More advanced classes could research answers to these questions online or in a library. See resources for websites that might help answer these and other questions.

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Learning Resources

Standards

National Science Education Standards
Content Standards, Grades K-4

Content Standard A: Science As Inquiry
a. Understandings about scientific inquiry

Content Standard B: Physical Science
a. Properties of objects and materials
b. Light, heat, electricity, and magnetism

Content Standard C: Life Science
a. Organisms and environments

Content Standard D: Earth and Space Science
a. Properties of earth materials

Content Standard F: Science In Personal and Social Perspectives
a. Characteristics and changes in populations

b. Changes in environments
c. Science and technology in local challenges

Content Standard G: History and Nature of Science
a. Science as a human endeavor

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Understandings about scientific inquiry

Content Standard B: Physical Science
a. Properties and changes of properties in matter
b. Transfer of energy

Content Standard C: Life Science
a. Populations and ecosystems
b. Diversity and adaptations of organisms

Content Standard F: Science In Personal and Social Perspectives
a. Populations, resources, and environments
b. Natural hazards
c. Risks and benefits