Education and Research: Testing Hypotheses

Finding Buoy Engineering Challenge

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Summary

This project will introduce students to current research being conducted in the Arctic, through the work of Dr. Hill at Old Dominion University. The WARM research project aims to collect light intensity and temperature measurements under the Arctic ice pack to determine the link between light penetration and surface ocean warming. In this lesson students are challenged by Dr. Hill to support her in her research, by designing and engineering a new prototype of the WARM buoy. Students also will be analyzing numerical and photographic data and presenting their findings and design to Dr. Hill.

[TAGS: Arctic, Engineering, graphing, Modeling, Sea ice]

Key Concepts - Grades 1 to 5

- Students will learn about current Arctic research, Marine science, ice, oceanography, scientific models, scale models, mathematics, creativity, design, engineering, graphing.
- Students will develop an sample model to support a response to the researchers challenge.
- Students will make observations to identify materials and their properties then communicate their observations and creations.
- Students will use numerical, photographic and measurable data based on an object's motion and weight to provide evidence that a pattern can be used to predict buoyancy.

Objectives

Include clear, measurable statements of what students will be able to do, such as:

- ***Observe*** and ***identify:*** an Arctic research project dealing with the effects of weight and temperature.
- ***Record and Analyze:*** compare and contrast properties of various materials.
- ***Designing and Building***: with different instruments and modifying results.
- ***Demonstrate***: ability to problem solve and weigh materials.
- ***Communicate***: results of different model systems

Materials

- mini bell peppers (used for buoys)
- jellybeans (used for buoys)
- ping pong balls (used for buoys)

- balloons (used for buoys)
- scale
- large, clear, rectangular, watertight tank or aquarium (shallow preferred, but not required)
- Gallon-size zip-loc bags
- water or ice cubes
- tablet or phone with video capability
- heat source for melting ice (if preferred for faster results)
- tape
- glue
- air dry clay
- fishing bobbers
- dental floss
- yarn
- pony beads
- washers
- lamp
- graphing paper
- pencils
- ruler
- thermometer

To engineer model:

- Diagram of WARM Buoy
- **You will need:** supplies to create and test the buoy's buoyancy depending on weight and temperature- to also include the large aquarium or containers to hold water (size can vary depending on classroom), lamp (light source), gallon size Ziploc bags, water, jelly beans, balloons, tape, straws, mini bell peppers, ping pong balls, air dry clay, yarn, dental floss, thread, fishing line, pony beads, mini paper clips, washer, etc. for things that float and things to hang on line to weigh down.

To incorporate data:

- Data sets:

  Trial documentation with Q & A

  Data set support

  Photos

- Maps of Buoy Drift of the Arctic WARMing Engineering Challenge

You will need to provide: graph paper, thermometer, scale, ruler, pencils, camera/video equipment for final report

Procedure

1. Lesson prep-draw the bottom of the large container. Use ruler to create buoys of proper lengths with bobbers, string, and clay weight on the end. Length is dependent on the depth of the frozen water or ice cubes in the container. Set up cameras at the sides of the container to monitor temperatures and buoyancy.
2. Begin designing ice floats. Students break into groups, each group will choose a different material and insert their buoy. Ice floats should be scaled to fit in the water container.
3. Groups take their turn deploying their ice floats, video and record results.
4. Replay video and record data of number of weighted items used in determining buoyancy of each buoy at designated temperatures.
5. Graph data. Compare with one of the 4 buoys as found at buoy maps. (link: https://sites.wp.odu.edu/BORG/current-projects/warm-buoy-maps/)
6. Re-engineer ice float. Test again as needed until the experimental results match the real data.

Assessment

- **Assessment rubric is provided**
- **Students share results of different ice float models to include what worked and what surprised them.**
- **Performance—During the lesson, students will demonstrate understanding how scientific models aren't perfect models of oceanography. As a reflection, students will share what inferences can be made with the data collected and what inferences should not be made.**
- **Product—During the lesson, students will construct a model of an ice float and demonstrate its ability to predict real world observations.**
- **Assessment should be directly related to the lesson objectives**
    - ***Measure buoyancy in relation to weight and size.***
    - ***Construct a sample model of a buoy and share successful samples with the entire class.***

- ***Communicate results of different models and its engineering*** *with different instruments made out of various materials to investigate the effect of buoy design on the model. (Good link: https://www.stevespanglerscience.com/lab/experiments/colorful-convection-currents/)*
- ***Compare and contrast properties of materials, then discuss why some models were not successful.***

Additional Resources

Websites:

Dr. Victoria Hill's website: https://sites.wp.odu.edu/BORG/current-projects/temperature-and-irradiance-measurements-in-the-arctic/

Life in the Arctic: http://www.thearctic.is/articles/overviews/homeland/enska/index.htm

National Snow and Ice Data Center: https://nsidc.org/

NOAA Ocean Currents: http://www.noaa.gov/resource-collections/ocean-currents

Lesson Extensions

Create a current by pouring warmed water into far corner of the ocean container. Try adding food coloring to the warmed water to visualize how temperatures mix. Or, if teacher has access to an aquarium bubbler or pump, that can be used to create a current.

For younger learners, add a narrative, such as an animal or person wanting to get to a place faster.