Arctic WARMing 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

* Students will learn about current Arctic research.
* Students will engineer a model to support as a response to the researchers challenge.
* Students will use numerical, photographic and map data to observe trends in research.
* Students will communicate their observations and creations.

Objectives

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

* ***Observe*** and ***identify:*** an Arctic research project dealing with light
* ***Record and Analyze :*** numerical data using graphing techniques, photographic data,
* ***Designing and Building*** a WARM buoy designed to assist Dr. Hill with her research.
* ***Demonstrate***: ability to problem solve.
* ***Communicate*** results with the class and Dr. Hill.

Materials

* Video of Dr. Hill & presentation of WARM research
* WARM buoy project background information for teacher

**To engineer model:**

* Diagram of WARM Buoy
* **You will need:** Supplies to create and test the buoy. Could include: large aquarium or containers to hold water (size can vary depending on classroom) paraffin, Styrofoam, marshmallows, bottle-caps, balloons, tape, straws etc- things that float and things to represent the camera. (Students could also bring in additional supplies)

**To incorporate data:**

* Data sets:

WARM Data Set for Buoy#3

Data set support

Photos

* Arctic Lat Long Map
* Maps of Buoy Drift of the Arctic WARMing Engineering Challenge

**You will need to provide:** paper, computer and/or camera/video equipment for final report**,** plain or graph paper for lesson extensions

Procedure

1. Read and review the WARM background resources.
2. Introduce the research(er) using the Video of Dr. Hill and PowerPoint presentation of WARM research- notes are at the bottom to support teacher knowledge.
3. Discuss with students Dr. Hill's surface camera buoy challenge and use WARM buoy diagram to support discussion.
4. Guide students to utilize supplies to create a model to meet Dr. Hill’s challenge, to add a surface camera to her WARM buoy that will not flip, sink or have negative relationships with the buoy such as hitting it or photographing only the buoy. Have students use diagram and have listed criteria WARM buoy diagram.
5. Guide students in creating a report to Dr. Hill in written and/or video format including their observations, final design, and personal challenges and successes. Reports can be sent to: Dr. Hill at [vhill@odu.edu](mailto:vhill@odu.edu)
6. Lesson Extensions
7. Data Observation and Analysis

a. Numerical graphing – Using excel or hand plotting, have students make graphs of select data. Data from buoy #3 (named Captain Carrot) is provided. Select data has been isolated which includes plots for hourly, daily, weekly and biweekly of temperature, light intensity and chlorophyll. Graph samples with annotations and helpful hints is also provided for your support. (Use: Data Set support)

b. Photos – Photos were taken from a 20m depth looking up. Photos provided are of weekly shots that will correlate well with the weekly numerical data. Photos can be used in a variety of ways. 1. Plot photo locations on Arctic Lat Long Map using the longitude and latitude coordinates. 2. Organize photos according to date, observing and discussing at what point the ice is melting and refreezing (melt July-August, freeze September- October). 3. Create an art project with photos connecting the research to the photo.

c. Maps of Buoy Drift of the Arctic WARMing Engineering Challenge – Maps can be used to discuss and compare location of buoys. Buoy #1 (named Commander Vimes) was sent from Barrow, AK followed ice drift westward. Buoy #2 (named The Patrician) was sent from the North Pole followed the transpolar drift and by luck ended up in Iceland and was retrieved by a farmer. Buoy #3 (named Captain Carrot) was deployed 100 km north of Prudhoe Bay also known as Dead Horse drifted west. Buoy #4 (named Nobby Nobbs) was deployed 200 km north of Prudhoe Bay and drifted west. It is assumed that this buoy got caught up in ice rafting (where ice collides and comes over top), the buoy was presumed to be crushed in May, because the last picture indicated it was covered in ice and not able to transmit data to satellite. However, in August Dr. Hill started to get data again from #4 after the ice began to melt (Use: Maps of buoy drift).

d. Have students research the relationship between the different names of the buoys. Answer: - Terry Prachett books The next buoys will be named #5- Rincewind, #6-The Luggage, Granny, #7-Weatherwax and #8- Nanny Ogg.

Assessment

* **Performance—**Students will experiment with and engineer a new WARM buoy design to incorporate a surface camera; students will document their experiences using written and/or video products
* **Product—**Students will create and analyze graphs, colors organized and model for camera; students will create a model to demonstrate their experimentation
* **Assesment –** Students will create a final report for Dr. Hill that includes diagram and/or picture, the design of their model, what supplies they used and successes and failures they encourntered.
* ***Assessment rubric is provided***

Additional Resources

Please list

Research website for Dr Hill, includes pictures from field work, publications and video diaries. https://sites.wp.odu.edu/BORG/