POLAR TREC
Learning Resources

Details

Completion Time: About 1 period
Permission: Download and Share

Who Will Melt First?

Overview

Even in Antarctica ice will melt. As the sun stays higher and higher in the sky as summer progresses, the warm sun causes the ice to melt. The questions that we are going to ask are: 1) Does clean ice (no sediment) or dirty ice (has sediment mixed in it) melt faster? and 2) Would the ice melt if all the sunlight were reflected away? To answer these questions we melted a piece of dirty ice, a piece of clean ice, and a piece of ice covered in aluminum foil while also recording the air temperature. Students will view the pictures, record the data, graph the data, and then interpret the results.

Objectives

All students will be able to describe albedo and how it affects the melting rates of ice and its implications towards climate change.

Lesson Preparation

This lesson is fairly easy to complete in one or two class periods with little or no preparation. If the students will view the pictures directly, they will need internet access. If computers are not accessible, the teacher could copy down the data and use this activity as a graphing and interpretation lesson. Before beginning this lesson, students should have the basic knowledge necessary to make their own line graph. They should also have some prior knowledge of the albedo effect and other factors leading to ice melt.

Procedure

1. Review the pre-lab questions together
2. Make hypotheses
3. Use the pictures on the PolarTREC Journal to fill in the data table
4. Use the data to complete the ice melt and temperature graphs
5. Interpret the graphs and answer the follow-up ques-

Materials

- Student Handouts
- Pictures of data from experiment (or the teacher can copy it down from the website and give the students the handout with the data already on it). (See Resources section)

tions
6. Review as a class

Extension
Do your own experiment! Make your own set-up with ice cubes with and without sediment to create clean and dirty ice. Have students record the results and compare it to our results.

Resources
Pictures available through the PolarTREC Journal at:
http://www.polartrec.com/expeditions/microorganisms-in-antarctic-glacier-ice/journals/november-11-2009-who-will-melt-first

Assessment
See follow-up questions on student handout

Credits
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Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

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

Content Standard F: Science In Personal and Social Perspectives
b. Populations, resources, and environments

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard F: Science In Personal and Social Perspectives
c. Natural resources
d. Environmental quality
f. Science and technology in local, national, and global challenges

Name: _____ Hour: _____

Who Will Melt First?

Even in Antarctica ice will melt. As the sun stays higher and higher in the sky as summer progresses, the warm sun causes the ice to melt. The questions that we are going to ask today are: 1) Does clean ice (no sediment) or dirty ice (has sediment mixed in it) melt faster? and 2) Would the ice melt if all the sunlight was reflected away?

Pre-Lab Questions:

1. What type of factors can you think of that might cause ice to melt faster?

2. What is the albedo effect? In what ways might it pertain to this experiment?

Problems: **#1:** Does clean ice or dirty ice melt faster in the same environment?
#2: Would the ice melt if all the sunlight was reflected away?

Hypothesis #1: Do you think the clean ice or the dirty ice will melt faster? Why?

Hypothesis #2: Do you think the ice would melt if all the sunlight was reflected? Why or why not?

The Experiment: (view pictures of the experiment on my journal page at www.polartrec.com)

1. Place similar sized chunks of clean ice and dirty ice into separate beakers. Place another similar sized chunk of clean ice into a beaker and cover it with aluminum foil.
2. Place all three beakers outside in a sunny location and set up a data logger to record the outside temperature during the experiment.
3. Record the amount of melt water produced from the ice every hour.
4. Graph the melting rates of each beaker.
5. Graph the temperature data from the same period of time.

The Data: (All the ice refroze after 7 hours so we resumed the experiment 24 hours later. The #'s in parentheses represent the actual time passed.)

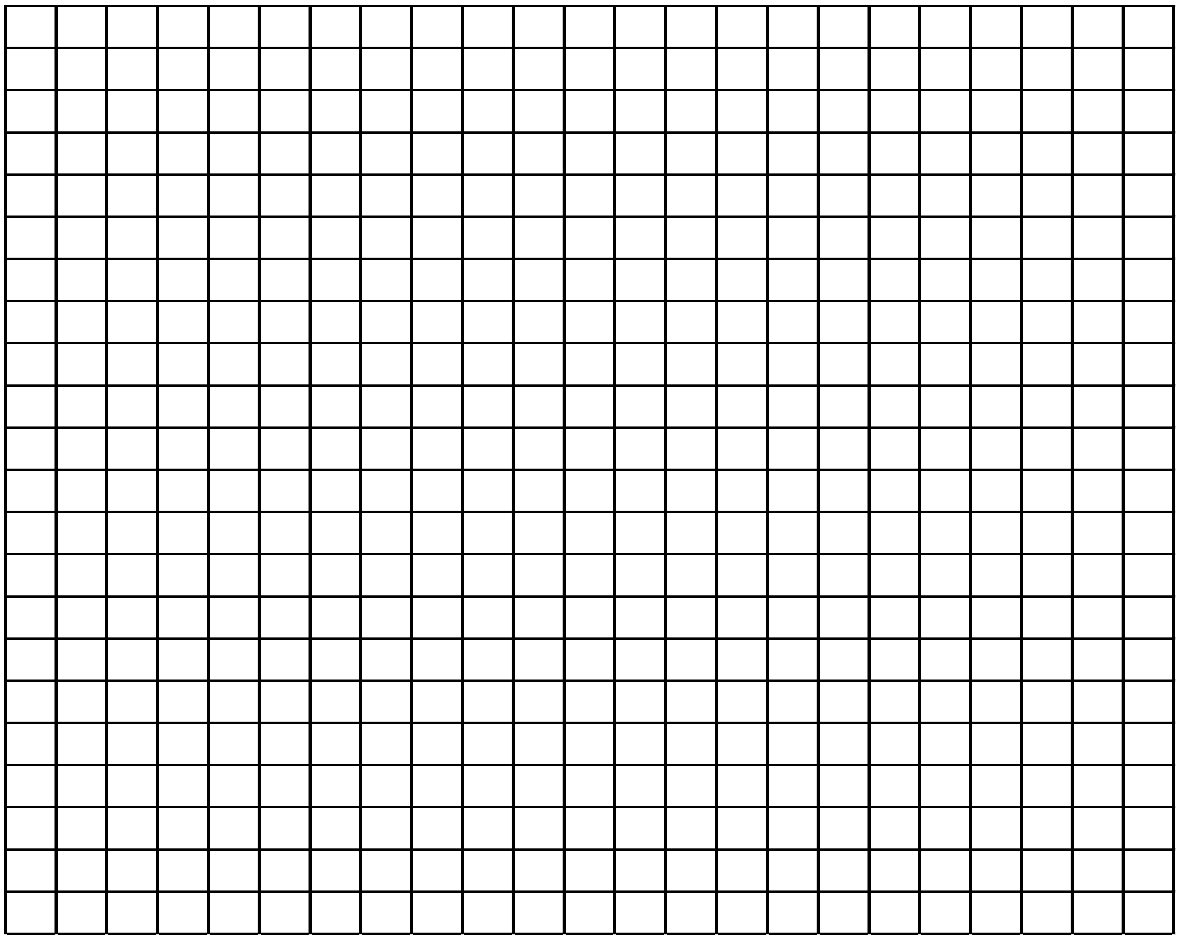
Table #1: Melt water measurements for the three beakers over 12 hours

Time (hrs)	Dirty Ice Melt Water (mL)	Clean Ice Melt Water (mL)	Clean Ice with Water Melt Water
1			
2			
3			
4			
5			
6			
7			
8 (25)			
9 (26)			
10 (27)			
11 (28)			
12 (29)			

*Graph the data collected in table 1 as a line graph with three separate lines (one line for each beaker).

Figure 1: Graph of the amount of melt water from each of the three beakers over the time frame.

The Amount of Melt Water Produced From Beakers with Clean Ice, Dirty Ice, and Clean Ice with No Sunlight



Interpreting the Melting Results:

1. Which beaker had the fastest melting rate? How do you know this?

2. Which beaker had the slowest melting rate? How do you know this?

3. Which melted faster, the dirty ice or the clean ice? Why do you think this occurred?

4. Why do you think the different types of ice refroze at different times?

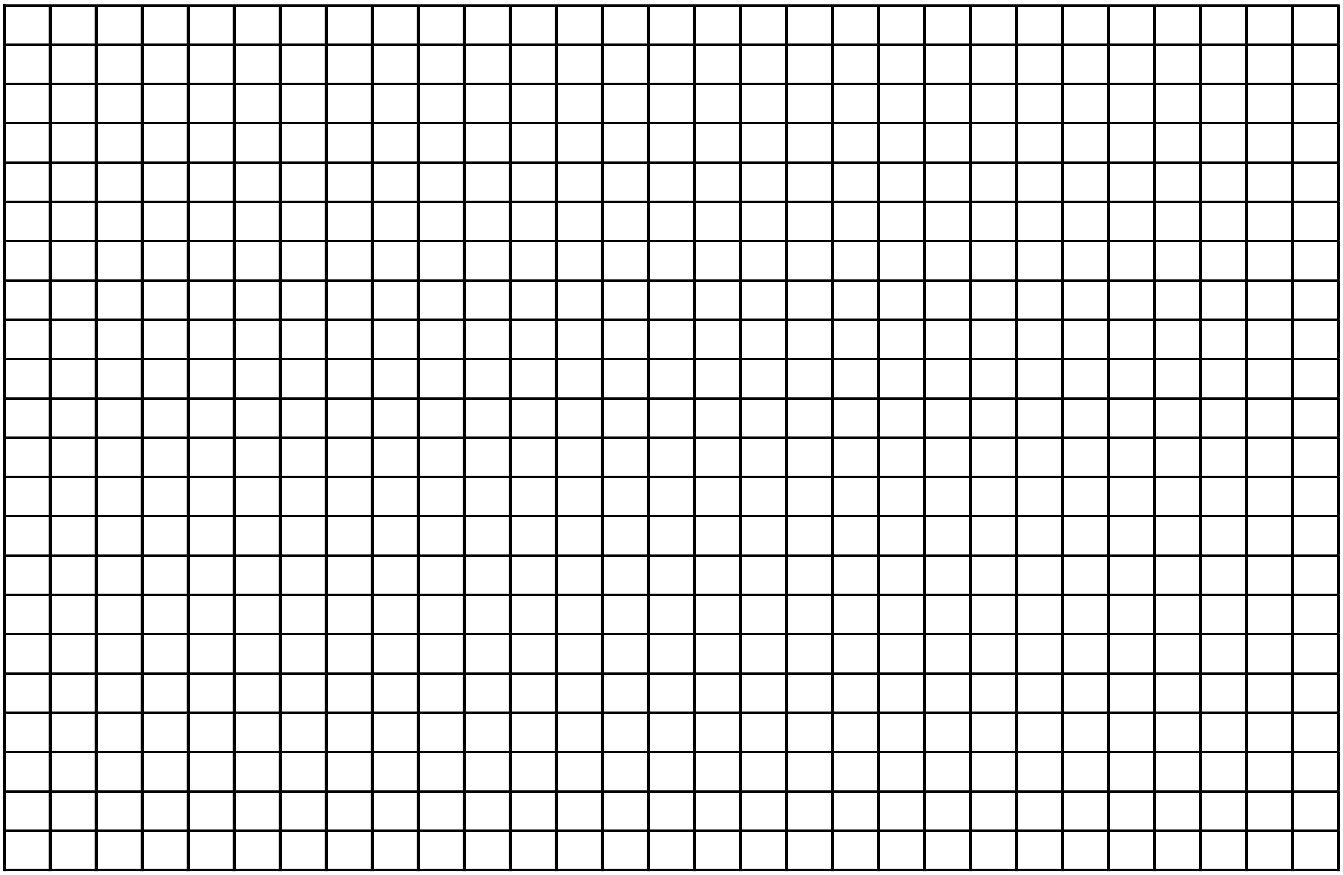
Table 2: The outside temperatures during the melting time period.

Table #2: Table of Outside Temperatures During Melting Period					
Time Elapsed (hours (time))	Temperature (°C)	Time Elapsed (hours (time))	Temperature (°C)	Time Elapsed (hours (time))	Temperature (°C)
0 (1pm)	13.6	11 (12pm)	-12.1	22 (11am)	18.6
1 (2pm)	13.9	12 (1am)	-12.9	23 (12am)	16
2 (3pm)	11.9	13 (2am)	-14.9	24 (1pm)	13.3
3 (4pm)	9.5	14 (3am)	-15.5	25 (2pm)	7.1
4 (5pm)	7.3	15 (4am)	-15.2	26 (3pm)	8.4
5 (6pm)	9.5	16 (5am)	-16.2	27 (4pm)	10.9
6 (7pm)	3.7	17 (6am)	-16.8	28 (5pm)	5.5
7 (8pm)	0.3	18 (7am)	-14.2	29 (6pm)	1.3
8 (9pm)	4.9	19 (8am)	-3.7	30 (7pm)	0.6
9 (10pm)	1.8	20 (9am)	3.1		
10 (11pm)	-10.4	21 (10am)	4.9		

*Graph the temperature data in table 2 into a line graph to show how the temperature changed during the time period when the ice was melting.

Figure 2: Graph of the outside temperatures during the melting period.

Outside Temperatures (without wind chill) During the Melting Period



Interpreting the Results:

1. Describe the outside temperature trend during the melting period from your graph.

2. Describe how the outside temperature changes affected the melting rate of the ice (use examples).

3. How did the aluminum foil cover affect the melting rate of the clean ice? Why do you think this occurred?

4. Do you think the clean ice or the dirty ice reflected away more of the sunlight? Why? (think of albedo)

5. How do you think the different melting rates of the clean and dirty ice affects the glacier? Why?

6. Look at the picture of the ice ripples.

Knowing what you know about the difference in clean and dirty ice melting rates, how do you think those ripples formed?

7. Knowing what you know about the albedo effect, as the white Arctic ice disappears and is replaced by the dark ocean below, what will happen to the Arctic Ocean temperatures? Why does this happen?