Teaching Activity: When Polar Ice Caps Melt

Background Information:

- Polar ice caps contain two percent of the available freshwater on the planet.
- Water locked up in the Antarctic ice cap alone equals approximately 17,900,000 km^2.
- The area of the Earth covered by water equals approximately 358,000,000 km^2.
- If the Antarctic ice cap melted, the rise in sea level around the world could be computed by the following formula:

$$\frac{\text{Vol. } H_2O \text{ in Ant. Ice}}{\text{Area covered with } H_2O} = \frac{17{,}900{,}000\ km^3}{358{,}000{,}000\ km^2}$$

The water level would rise approximately 50 meters.

- The same formula could be used in this activity by substituting:

$$\frac{\text{Vol. } H_2O \text{ in Ant. Ice}}{\text{Area of Earth covered with } H_2O} = \frac{\text{Vol. } H_2O \text{ in ice block}}{\text{Area of pan covered with } H_2O} = \text{rise in sea level}$$

*** PUT THIS FORMULA ON THE CHALKBOARD FOR EASY REFERENCE DURING THE ACTIVITY.

Objective:

- To simulate the melting of the polar ice caps and the effect it would have on the world's coastal regions;

Important Terms: Polar ice caps, freshwater, Antarctic ice cap, km^2/km^3, sea level;

Materials: Student Activity Sheets #1 and #2, large flat pan, sand and pebbles, block of ice, ruler (mm), calculator;

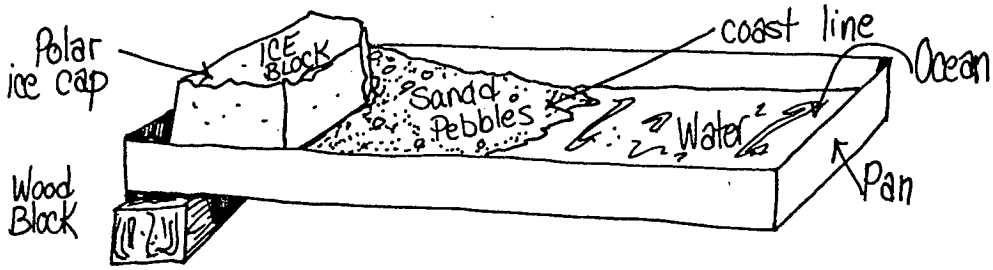
Procedure:

NOTE: This may be done as a demonstration set up for the entire class or several smaller models for group activity.

1. Two days before the investigation freeze some ice blocks and get together enough sand and pebbles to fill half of the pan.

- Depending on the size of the ice block and the air temperature, you can plan for one-two days for complete meltdown of the ice.

- Allow two 45 minute periods for completion of the activity.



2. On the first day, pass out **Student Activity Sheets.**
   - Measure and record the volume of the ice block, the water surface area and the depth of the water.
   - Students should compute and record this information on their work sheets.

3. Students should then follow the directions throughout their **Activity Sheets.**

4. Instruct students to answer the questions in the **ANALYSIS** section at the end of the activity.

EXTENSIONS:

- Make a clay model of a sea coast region. Fill the pan with water to the existing sea level. Support a block of ice off shore on some sand and pebbles. Observe the melting of the ice cap and its effect on the coastal region.

- Calculate the rise in sea level in the event of a total polar ice cap meltdown. What would the effect be on coastal areas?

Student Activity Sheet #1: When Polar Ice Caps Melt

PART I: OBSERVATION/CALCULATION

1. Measure the depth of the water in the pan at its deepest point.
   Depth at deepest point = _____mm

2. Measure and compute the volume of the block of ice.
   (Volume = length x width x height)
   Length = _____mm
   Width = _____mm
   Height = _____ mm

   VOLUME = _____mm^3

3. Measure and compute the area of the water surface.
   (Area = length x width)
   Length = _____mm
   Width = _____mm

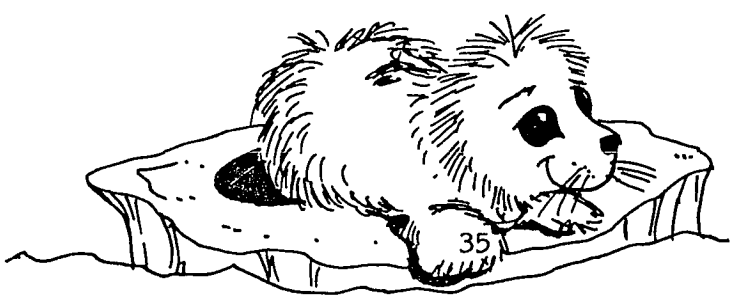
   SURFACE AREA OF WATER = _____mm^2

4. Predict the rise in water level after the ice melts .
   - Divide the volume of the ice block by the area of the water surface.

   $\frac{\text{Volume of ice block}}{\text{Area of water surface}}$ = _____mm^3 / mm^2 = _____ mm rise in water level

5. Every hour during the melt down time of the ice cap, observe what is happening to the model. Answer the following questions:
   a. What is happening to the block of ice? _____
   _____
   _____

   b. What is happening to the sand under the block of ice? _____
   _____
   _____

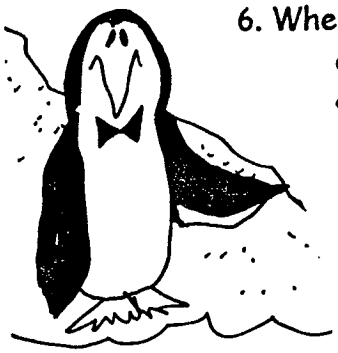


Student Activity Sheet #2

c. What is the difference between the sand under the ice block and the sand not under the ice block? _____

_____

_____



6. When the polar ice cap (ice block) has completely melted, measure the depth of the water in the pan at the deepest point.

- Subtract your original measurement (depth before the ice cap melted) from the final (after the ice cap melted) measurement.

After ice cap melt = _____mm

Before polar ice melt = _____mm

Measured rise in Water level = _____ mm

7. How close was your prediction to the actual rise in water level?

Mathematical prediction of rise in water level = _____mm

Measured rise in water level = _____mm

Difference between the two = _____mm

8. Investigate the area of sand that was under the block of ice and compare it to the area of sand that was not under the block of ice. Write down your observations.

_____

_____

_____

_____

_____

PART III: ANALYSIS

1. What were the 4 main science processes you used in this activity?

_____

_____

2. What does the block of ice represent? _____

_____

Student Activity Sheet #3

3. Research the average total area in winter of the Arctic and Antarctic ice caps. Which is larger, the Arctic or the Antarctic ice cap? By how much? _____

4. What percent of the Earth's surface water is contained in the polar ice caps? (Total surface area covered by water = 358,000,000 km^2)

5. What does the area of the pan covered with water represent?

6. In what way is this model similar to what happens on the surface of the Earth? _____

7. What kinds of errors occur when any model is used? _____

8. Despite the errors in the model, what did it help us to see? _____