Disappearing Snow

Activity Summary:

This is an inquiry activity that allows students to observe the properties of a surface that contribute to the albedo effect in the Arctic where effects of global warming are easily recognizable and often dramatic.

Background:

One impact on global climate is surface reflectivity (also called albedo). Albedo is the ratio between the amount of light reflected and total incoming light. Light-colored surfaces reflect more light and darker surfaces absorb more light. This is why wearing black clothes on a sunny day feels so much warmer than wearing white clothes. Snow and ice covers much of the Arctic land and ocean. Because snow and ice is bright white, as much as 90% of the solar energy that hits them reflects back into space. When warmer temperatures melt the snow and ice, the darker colored vegetation or ocean water below reflects less than 10%-20% of the incoming solar radiation. The rest of the energy is absorbed instead of being reflected and further heats the oceans, land, and surrounding air which in turn causes more melting. This is a "positive feedback loop" because the process of melting snow and ice due to warmer temperatures creates conditions that melt even more snow and ice. The graphic below illustrates how surface reflectivity changes depending on the earth's surface. The effect of albedo is not limited to just the Arctic, however, the melting caused by the albedo effect is easily seen as glaciers and ice caps melt and cause the sea level to rise faster than was previously calculated.

Albedo Effect:

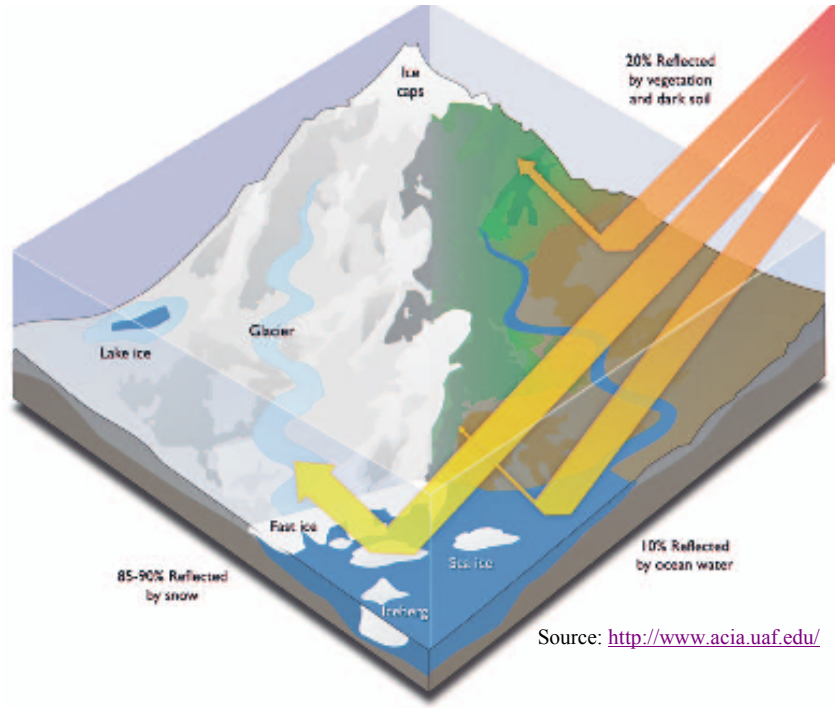
The albedo effect is the phenomenon that occurs when snow and ice melts in polar regions and the albedo of the earth's surface (the ability of a surface to reflect light and heat) is reduced. The greater the albedo of a surface, the more light and heat is reflected.

Materials Needed per Group:

-1 Square of black felt
-1 Square of white felt
-2 Thermometers
-1 Heat producing light source

Directions:

1. Bring both thermometers to room temperature and have students' record the temperature of each thermometer.
2. Place the thermometers on the tray.
3. Cover one thermometer with the black felt and another with the white felt.
4. Place trays under a lamp.



Source: http://www.acia.uaf.edu/

Notes:

Students may ask why the Arctic warms more quickly than the rest of the world. In addition to the effect of albedo explained in this lesson, there are three additional factors. First, in the tropics much of the extra energy from the heat trapped at the surface goes into evaporation. By contrast, in the Arctic, a much higher percentage of that extra heat goes directly into warming the atmosphere. Second, in the Arctic, the layer of the atmosphere that has to warm in order to warm the surface is much thinner than that same layer in the tropics (~5 miles in the Arctic versus ~9 miles in the tropics). Third, alterations in the circulation patterns of the atmosphere and oceans can bring more heat to the Arctic.

Here are a few other ideas:

After recording the thermometers' temperatures, place each thermometer under the same amount of potting soil. Place snow over one mound of potting soil. Place in a sunny window for 5-10 minutes. Read the temperatures of each thermometer. Is there a difference? Try recording the soil temperature in both snow covered areas and bare ground areas. How about using a reflective surface along with the other materials?

Student Handout

Student Name _____ Date _____

Materials Needed per Group:

1 Square of black felt
1 Square of white felt
2 Thermometers
1 Heating producing light source

1. Bring both thermometers to room temperature. Record the temperature of each thermometer.

#1 _____degrees Celsius #2 _____degrees Celsius

2. Place each thermometer on the tray. Place both squares of felt on your tray over the thermometers.

3. Place the tray under/in the light source making sure they are equal distances away from the light source. Keep the thermometers under/in the light for fifteen minutes.

4. Record the temperatures (after 15 minutes).

#1 _____degrees Celsius #2 _____degrees Celsius

5. What is the result?

_____

_____

6. How could you connect this experiment to the albedo effect and what's happening in the Arctic?

_____

_____

_____

_____

© Will Steger Foundation