



Hot Times in Alaska

Activity 1: Grades 9-12

Light Absorbption & Temperature Rise

As global temperatures rise, ice melts and glaciers retreat. In Alaska, the retreating glaciers expose the ground below. Unlike ice and snow cover, the exposed land surface is not highly reflective. Instead, the ground absorbs much of the sunshine that falls upon its surface. This energy is transformed into heat. The heat adds to global warming and leads to increased melting.

This activity page will offer:

- A hands-on experience in the transfer of energy
- An arena in which to observe temperature rise associated with sunlight
- The opportunity to compare and contrast how color affects energy absorption
- Insight into solar water heats

Heating Up

The amount of light energy that an object absorbs depends upon its appearance. The brighter an object is, the more light it reflects. The reflecting leaves less light for absorption. The darker the object, the less light it reflects. This results in more light energy being absorbed. In this activity, you'll create two models of the Earth's surface. These models will differ in the reflective surface. You'll observe how these differences affect a greenhouse representation of the Earth.

Materials

- Two thermometers
- Two cardboard pizza boxes
- White paper
- Black paper
- Tape
- Paste
- Plastic wrap
- Scissors

Procedure

1. Work in groups of four. Take two cardboard pizza boxes. Remove the covers of both boxes.
2. Use strips of black and white paper to produce a striped pattern in the bottom of both boxes. One box should have $\frac{3}{4}$ of the area covered with black paper. The other box should have $\frac{3}{4}$ of the area covered with white paper.
3. Use tape to attach a thermometer to the side of the box.
4. Cover the open tops of the boxes with a layer of plastic wrap.
5. Place the boxes in the shade. Wait 10 minutes. Observe and record the temperature displayed by each thermometer.
6. Place both boxes side-by-side in direct sunlight. Make sure that the thermometers remain out of the direct rays of the sun.
7. Every five minutes, observe and record the temperature displayed by each thermometer. Make a table to display your results.

Questions

1. Which of the box bottoms reflected the most light?
2. Which of the box bottoms absorbed the most light?
3. Which box showed the fastest temperature rise? Why?
4. Which box showed the slowest temperature rise? Why?

Critical Thinking

How can your observed results be applied to the construction of solar water heaters?

Albedo

The term albedo (al-BEE-dough) is a measure of the amount of light reflected by a surface. Snow has an albedo of almost 1. Sand has an albedo of about 0.35. Coal has an albedo of about 0.05. Based only upon their albedo values, which of these materials heats up first when placed in the sun? Explain.

From Below

Thunderclouds have a very high albedo of around 0.9. Yet, these clouds look very dark when viewed from the planet's surface. Explain.

Greenhouse on Wheels

Develop a strategy for inquiry that would explore whether tinted car windows influence the greenhouse effect inside a closed automobile. Share your experimental design with your instructor. With his or her approval, perform your investigation. Report your results back to the class in an oral presentation.

Web Connection

Global Warming Links

<http://www.autobahn.mb.ca/~het/globalwarming.html>

The site presents a library of hyperlinks to global warming URLs.

Albedo

<http://www.arcticice.org/albedo.htm>

The site offers a brief presentation of reflected sunlight and its relationship to the arctic environment.

EPA: Global Warming: Impacts: State Impacts

<http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsStateImpacts.html>

This site hosted by the U.S. Environmental Protection Agency offers a state-by-state overview of the impact of climatic change and global warming.

Academic Advisors for this Guide:

Suzanne Panico, Science Teacher Mentor, Cambridge Public Schools, Cambridge, MA

Anne E. Jones, Science Department, Wayland Middle School, Wayland, MA

Gary Pinkall, Middle School Science Teacher, Great Bend Public Schools, Great Bend, KS

Cam Bennet Physics/Math Instructor Dauphin Regional Comprehensive Secondary School
Dauphin, MB Canada



Hot Times in Alaska

Activity 1: Grades 5-8

Energy Absorption

Questions

1. Which of the box bottoms reflected the most light?
(The box that had 3/4 of its surface covered with white paper)
2. Which of the box bottoms absorbed the most light?
(The box that had 3/4 of its surface covered with white paper.)
3. Which box showed the fastest temperature rise?
(Box with 3/4 black bottom.)
Why? **(It absorbed more of the light energy that fell upon its surface.)**
4. Which box showed the slowest temperature rise?
(Box with 3/4 white bottom.)
Why? **(It reflected more of the light energy that fell upon its surface.)**

Critical Thinking

How can your observed results be applied to the construction of solar water heaters?

(Paint the water heaters and exposed pipes black. This way they can absorb more of the sun's rays and convert that visible energy into heat.)

Albedo

The term albedo (al-BEE-dough) is a measure of the amount of light reflected by a surface. Snow has an albedo of almost 1. Sand has an albedo of about 0.35. Coal has an albedo of about 0.05. Based only upon their albedo values, which of these materials heats up first when placed in the sun? Explain.

(Coal. With a low albedo value, it absorbs more light. This light is changed into heat and generates a greater temperature increase.)

From Below

Thunderclouds have a very high albedo of around 0.9. Yet, these clouds look very dark when viewed from the planet's surface. Explain.

(The upper surface of the clouds reflects most of the sunlight that falls

onto them back into space. Therefore from a non-terrestrial vantage, they look very bright. Since little light spills beneath the clouds, from the surface they appear dark.)