POLAR TREC
Learning Resources

Details

Completion Time: Less than a week
Permission: Download, share, and remix

Staying Warm in Antarctica!

Overview:
We all know that Antarctica is a very cold place, and the scientists who work there are not the only ones who have to worry about staying warm. The animals that live in Antarctica have to protect themselves from the frigid conditions on a year-round basis. In order to keep heat they produce from escaping into the environment, these animals are typically well insulated. This lesson was created by Brandon Gillette after spending 2-weeks in the storm blown WAIS Divide.

Objectives:
Students will explore the three different types of heat transfer and gain a better understanding of how this affects both scientists and animals that inhabit Polar Regions.

Lesson Preparation:
Your goal is to cool one can down as much as possible, while keeping the other can as warm as possible.

Heat can be transferred in three ways:

1. Conduction is the transfer of thermal energy through matter by direct contact of particles. During conduction, heated particles collide with each other and transfer their energy. Materials that transfer thermal energy well are called conductors (example: metals). Materials, which do not transfer thermal energy well, are called insulators (example: wood and plastic).

2. Convection is the transfer of thermal energy

Materials

- Four small zip-lock bags
- Two cups of vegetable shortening
- One large bowl filled with ice water (Ice bath)
- Empty aluminum pop cans (2 per group)
- Styrofoam / Packing Peanuts
- Socks / Quilt Batting / Fabric Scraps
- Tape / Glue
- Construction Paper / Newspaper
- Aluminum Foil
- Scissors
- LabPro Temperature Sensors (thermometers)

by the movement of heated particles. During convection, the more energetic particles in a liquid or gas move from one location to another and carry their energy along with them. Liquids and gases move when we add heat because they become less dense and are able to rise. When the fluid rises, it carries its energy with it.

3. Radiation is the transfer of thermal energy by electromagnetic waves. These waves can travel through space even when matter is not present. Electromagnetic waves include things like radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. All objects emit some type of radiation. Hotter objects emit shorter waves, while colder objects emit longer waves.

Procedure:
Activity 1: You are going to look at how a layer of blubber can help to keep you warm. If you place one bare hand and one hand with a blubber glove into an ice bath, predict which hand will be able to withstand the water longer.

1. Prepare an ice bath (fill the large bowl with ice and then cover with water).
2. Record the temperature of the ice bath throughout the experiment.
3. Smear a layer of shortening (1-2cm) inside on plastic bag.
4. Place the second plastic bag inside the first bag. Place your hand inside the blubber mitt and form the lard around the shape of your hand.
5. Place a rubber band around the end to hold bag onto your wrist. Then place both of your hands into the cold water, making sure water does not leak in to the mitt.
6. Compare how long you can leave each hand in the water.

Activity 2: Using the concepts of heat transfer your goal is to make one can cold and one can warm.

1. Prepare a data table with temperature and time for both cans.
2. Fill 2 cans with tap water (approximately the same temperature).
3. Use the various lab materials to cool one can down as much as possible, while keeping the other as warm as possible.
4. Using the temperature probes (thermometers) take measurements on both cans, record data at one-minute intervals.
5. Using the data collected create a graph showing the changes in temperature.
6. Write a brief explanation of how you designed each system. Explain why you chose the various materials.

Extension:
After the "can" experiment, you should have a better understanding of which materials are good conductors and which materials are better insulators.

To truly test your knowledge of heat transfer, and to allow you to show some of your creativity, design a "survival suit" for an Arctic/Antarctic researcher. Prior to designing your suit, research how the scientists whom are currently in the Arctic and Antarctic stay warm.

You will be required to provide both a picture of your suit and a written description of how your suit will work. Take your time and be creative!

Resources:
N/A

Assessment:
N/A

Credits:
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Learning Resources

National Science Education Standards (NSES):

NSES Content Standards, Grades K-4
Content Standard B: Physical Science
a. Properties of objects and materials
c. Light, heat, electricity and magnetism

Content Standard C: Life Science
a. Characteristics of organisms
c. Organisms and environment

Content Standard E: Science and Technology
b. Understandings about science and technology

Other Standards:

N/A