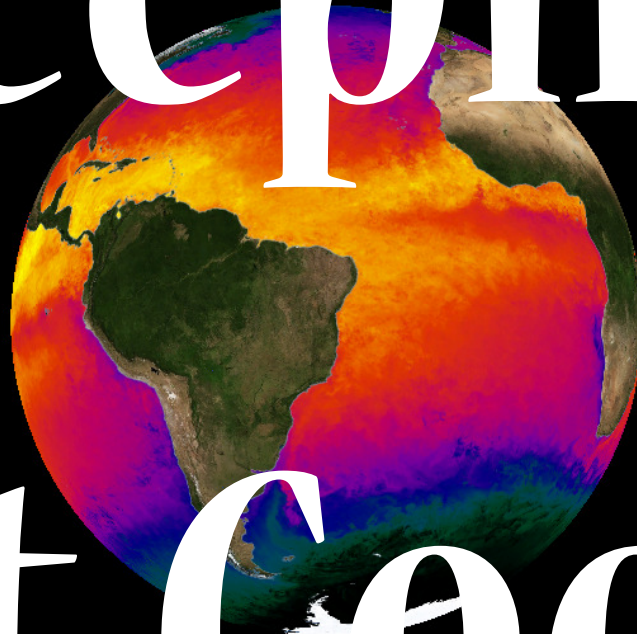


Keeping



It Cool

*Ice Worlds
Supplementary
Material*

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The Thermal Bag Challenge

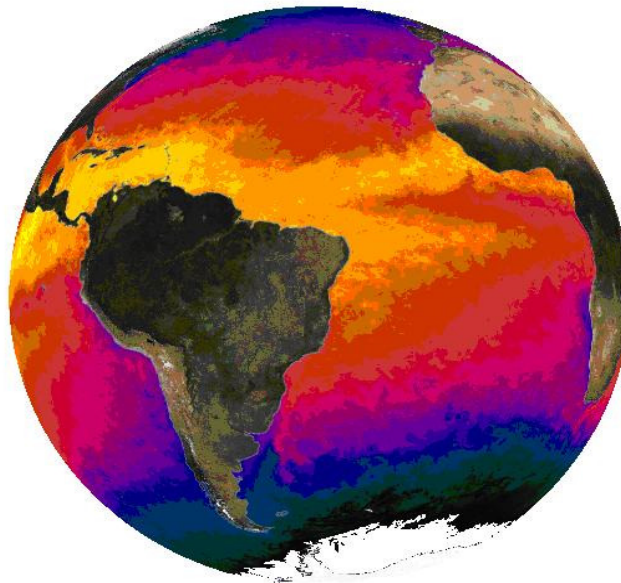
Introduction

Heat flow is the transfer of energy from a warmer object to a cooler object. Cold is the *absence* of heat. So when you touch something cold, like ice, the heat is transferred from your hand to the ice via conduction.

Conduction is the transfer of energy through direct contact. In warmer objects, the molecules are moving faster within the object. The warmer molecules transfer this motion to the slower-moving molecules in a cooler object through conduction when the two objects touch. In a good heat conductor, the molecules move easily and transfer their motion from molecule to molecule.

An object that does not warm up quickly when touching a warmer object is called an insulator. The molecules in an insulator are less able to vibrate and/or are farther apart, making conduction of the molecular motion more difficult.

Convection is the movement of heat in a fluid. Warm fluid rises because it is less dense than the surrounding fluid. As the warmer fluid cools, it becomes denser and sinks. This cycle occurs naturally everyday through ocean currents and weather. As you can see in the thermal image of the Earth below, the warm colors (reds, oranges, and yellows) represent warm water while the cool colors (greens, blues, and purples) represent cold water. The water near the equator is warm because of solar heating. The warmer water moves over cooler water toward the Poles. As it cools off, the water sinks and returns to the equator, completing a current loop.



In this activity you will observe the properties of heat in a “thermal” bag. What is a “thermal” bag you ask? As you recall, heat flows from a hot object to a cold object. If you have a hot plate of brownies, you leave them to cool off before you eat them. The heat from the brownies is transferred to the plate, the table, and the surrounding air. In order to protect certain foods and liquids from changing temperature (either hot to cold, or cold to hot) you can use a thermal bag, which insulates the food.

Why do you think a thermal bag works like it does? What properties of insulation are used? FIND OUT.

Materials

Required Materials

- Ice cube
- Thermal bag
- Paper bag
- Cooler
- Heat source (may be sun or large heat lamp)
- Stopwatch
- Thermometer
- Plastic bags

Procedure

- 1) Measure the temperature outside. (Or in the room if you are using a heat lamp)
- 2) Place the paper bag, thermal bag, and cooler outside in the sun on a warm day.
- 3) Put an ice cube in a plastic baggy in each of the containers. Start the stopwatch.
- 4) Fill out the student worksheet as you wait for the ice to melt. Check periodically in each container to see if it has melted. Make sure that you check briefly and at the same time and frequency for each bag. Once the ice does melt, check the time by which it melted and record it in the table on your student worksheet. (Open the 3 containers for the same amount of time as you check on the ice)
- 5) Continue filling out the student worksheet after you observe which ice cube melted first.
- 6) OPTIONAL. If you have a scale available, you can leave the cooler, thermal bag, and paper bag out for the same amount of time. Bring all three ice baggies inside and pour out the water. Immediately weigh the remaining ice to see which container kept heat out the most.

Conclusions

A thermal bag is made of three layers. The first layer you see is a reflective layer. A reflective material deflects most of the sun's heat before it reaches the inside of the container. The second layer is made of small foam capsules. These are sealed and allow the bag to be flexible. The final layer is a protective layer inside the bag made of polyethylene. Polyethylene is a durable plastic that is used in shopping bags as well. On top of the polyethylene, a sealant maintains taste and temperature.

What other ways could you insulate a thermal bag? What else can you do to insulate yourself? Think up some experiments that you can try! Use what you have learned to keep a miniature house cool in the next activity.

Student Worksheet

Name: _____

- 1) What is the outside temperature?
- 2) Which container do you think would melt the ice the fastest?
- 3) Which container do you think would keep the ice frozen the longest?
- 4) Record the time it took for the ice to melt in each of these containers:

	Time it took to melt
Paper bag	
Thermal bag	
Cooler	

- 5) Which container melted the ice the fastest? How long did it take? Were you wrong in your predictions? Why do you think it melted the ice the fastest?
- 6) Which container kept the ice frozen the longest? How long did it take? Were you wrong in your predictions? Why do you think it kept the ice frozen?
- 7) What do you think the thermal bag is made of that keeps heat/cold in?

Making a Cool House

Introduction

Here in Houston, one of the greatest problems facing people in the summer is the high cost of energy (air-conditioning). To combat this problem, researchers and ordinary people alike are trying to find new and innovative ways to keep the heat out.

As you learned in the previous activity, certain insulators slow heat transfer, resulting in either the cool remaining cool, or the hot remaining hot. With rising temperatures and rising utility bills, it is becoming more and more important to conserve energy. The easiest and most effective way we can keep the house cool without overusing the air conditioning is by making your house as efficient at keeping heat out as possible.

Some materials that people use for buildings are specially made to control heat flow. Your goal in this activity is to maintain a cool temperature in an enclosed space without using air conditioning!

Materials

Suggestions (you can choose others if you wish):

- Aluminum foil
- Plastic wrap
- Styrofoam
- Bubble wrap
- Fiberglass
- Copper Sheets
- Cloth (cotton, wool, or other)
- Wood
- Batting
- Cardboard
- Paper (experiment with different colors and thicknesses)
- Foam
- Mirrors (or other reflective surfaces)
- Wax
- Plaster
- Clay (or other ceramics)

Required Materials

- Shoebox
- Ice cubes (of same size)
- Stopwatch
- Ziplock bags (to put ice cubes in for observation)

Procedure

- 1) The average room has approximately one window and one door. In your shoebox, cut out a window (3x3in) on any side you want. (Keep in mind you will observe the rate at which your cube melts through the window)
- 2) For the door, it may be more convenient for you to flip the box over (so that the lid is on the table) then cutting the door can be done more easily. Make sure not to simply cut an open door, leave a flap in to simulate a real door. Your door should be (2X4in).
- 3) Now, you have the option of insulating the house to your choosing. You may choose to cover the window, or leave it uncovered. You can use glue, tape, staples or anything other attachment methods. Keep in mind about the actual insulation design of a real house.
- 4) In class, bring in your finished room.
- 5) At the same time, everyone will put an equally sized ice cube into the room.
- 6) Your teacher will then immediately start a stopwatch.
- 7) Observe through your window how long it takes for your ice cube to melt.
- 8) While you observe, fill out the student worksheet.

Conclusions

After you finish experimenting, research on how to keep the cold in and the heat out. Many different things in your home affect how well you maintain the cold temperature inside it.

One of the most efficient ways to keep the heat out is to stop it from getting into your house. Putting reflective film on your windows, shade in front of the window, and curtains or blinds on the window are useful in preventing heat energy from sunlight into your house. Additionally, fill in cracks in walls or the flooring. Cold air falls, which causes it to seep into the ground where there are cracks. Your roof is also very important. Any hot air needs to vent out of the roof. However, it would not be very efficient to have no roof at all. Many suggest that a false roof is built beneath the actual one. In between these there is a layer of insulation that allows hot air to vent out while the solid false roof keeps in the cold air. In any case, reflective material is best in increasing cold conservation. Putting this material on your windows or in your roof keeps out a lot of heat.

Before a building is even built, it is best to consider where to put the windows in order to optimize heat conservation. The building must also have a good layout where rooms will all flow into one another for better air circulation. You can repeat this activity, giving the shoebox a custom roof.

