

Soaking up Rays

Overview: It's a blistering hot day and you want to wear something cool. Will you choose the dark- or light-colored outfit? Is there science involved in fashion? You bet!

What to Learn: You should discover that the sun transfers its heat in a process called radiation and that dark colors absorb the infrared radiation while light colors reflect it.

Materials

- 2 ice cubes, about the same size
- white piece of paper
- black piece of paper
- a sunny day

Experiment

1. Put the black paper and white paper on a sunny part of the sidewalk.
2. Put the ice cubes in the middle of the pieces of paper.
3. Wait. Record approximately how long it took for each ice cube to melt.

Soaking Up Rays Data Table

Color of Paper	Size of Ice Cube	Time to Melt

Reading

There are three ways to transfer heat: conduction, which means two objects touching; convection, where one of the objects is a fluid like water or air; and radiation, which doesn't need to be touching anything at all. Heat is transferred by radiation through electromagnetic waves. Energy is vibrating particles that can move by waves over a distance. If those vibrating particles hit something and cause those particles to vibrate, those particles begin to move faster, causing a temperature increase. The types of electromagnetic waves that transfer heat are infra-red waves.

If you hold your hand near an incandescent light bulb, you begin to feel heat on your hand. This is an example of heat traveling like a wave. This type of heat transfer is called radiation.

Now, don't panic. This is not a bad kind of radiation like you get from X-rays. It's infra-red radiation. Heat was transferred from the light bulb to your hand. The energy from the light bulb caused the molecules in your hand to resonate. Since the molecules in your hand are now moving faster, they have increased in temperature. Heat has been transferred! In fact, an incandescent light bulb gives off more energy in heat than it does in light. They are not very energy-efficient.

Now, if it's a hot sunny day outside, are your students better off wearing a black or white shirt if they want to stay cool? This experiment will help them figure it out. What they should eventually see is that the ice cube on the black sheet of paper melts faster than the ice cube on the white sheet. Dark colors absorb more infra-red radiation than light colors. Heat is transferred by radiation easier to something dark-colored than it is to something light-colored and so the black paper increases in temperature more than the white paper.

So, to answer the shirt question, a white shirt reflects more infra-red radiation so it will stay cooler. White walls, white cars, white seats, white shorts, white houses, etc. all act like mirrors for infra-red (IR) radiation. This is why you can aim your TV remote at a white wall and still turn on the TV. Simply pretend the wall is a mirror (so you can get the angle right), and bounce the beam off the wall before it gets to your TV. It looks like magic!

Exercises

1. How long did it take for the ice cube on black paper to melt? _____
2. How long did it take for the ice cube on white paper to melt? _____
3. What can you discover about light versus dark colors and the infra-red radiation of the sun based on this experiment?
4. What are three ways heat can be transferred?

Answers to Exercises

1. How long did it take for the ice cube on black paper to melt? (answers will vary)
2. How long did it take for the ice cube on white paper to melt? (answers will vary)
3. What can you discover about light verses dark colors and the infra-red radiation of the sun based on this experiment? (Light colors reflect the infra-red radiation of the sun, and dark colors absorb it.)