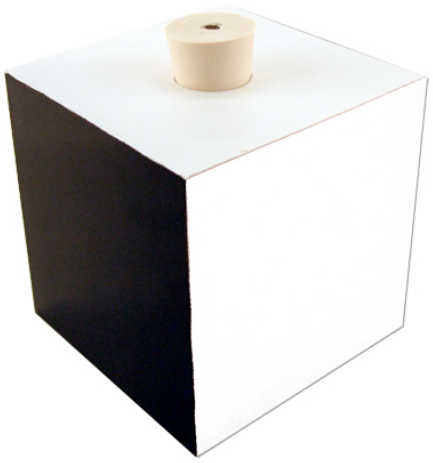
Hot Topic: Heat Energy & Color

Heat transfer happens three different ways: conduction, convection, and radiation. When you walk outside and feel the warmth of the sun, that's radiant energy.

You may have noticed that when you wear a black t-shirt outside on a sunny day, you feel hotter than you do when you wear a white one. But why is that? Different colored materials **absorb** and **reflect** light differently, which affects how quickly or slowly they heat up.

In this investigation you will compare the rates of temperature change for different colored materials using a device known as Leslie's cube. The four sides of a Leslie's cube are covered with materials that are different colors and different finishes: white, matte (not shiny) black, glossy black, and shiny tin. The cube is hollow and is filled with air. When you shine a light on each side of the cube to find out which color and finish transfers the most heat energy to the air inside the cube in a given amount of time.



Vocabulary

- **absorb:** to take something in (for example, light or water) rather than letting it pass through or reflect
- **reflect:** to bounce back

What You Need

- 1 Leslie's Cube
- a 2 liter beaker filled with room temperature water (approximately 70 °Fahrenheit).
- 1 Vernier Go!Temp probe
- 1 table lamp
- 1 computer

The Experiment

1. Look at the four sides of the cube and make a prediction about how shining the same lamp on each side of the cube will affect the temperature of the air inside the cube. Which side do you think will transfer heat to the air inside the cube the fastest when you shine light on it? Second fastest? Third fastest? Slowest? Explain your predictions.

I think the _____ side will heat the air fastest.
Reason:

I think the _____ side will heat the air 2nd fastest.
Reason:

I think the _____ side will heat the air 3rd fastest.
Reason:

I think the _____ side will heat the air slowest.
Reason:

2. Place the temperature probe in the hole in the stopper on top of the cube. Set up the probe to collect data for 10 minutes with a temperature reading every second.
3. Choose which side you will test first. Adjust the table lamp to shine directly on that side of the cube. Place the lamp within 1 inch of the side. Turn the lamp on and start recording data.
4. After 10 minutes, remove the probe and stopper and fill the cube with room temperature water to return the cube to its starting temperature. Also dip the probe in the water to return it to room temperature. Empty the cube and dry off both the cube and the probe to prepare to run the next test.
5. Repeat Steps 2-4 for each of the colored sides of the cube, using the **exact same setup**. Make sure you always start at the same temperature.

Analysis

1. Describe what happened during your experiment. Was your prediction correct? Using the data you collected, explain how your prediction was supported or how the results were different from what you predicted.

2. Based on your results, explain the relationship between the color and finish of a material and how fast that material absorbs heat energy.

3. If you were going to be out in the desert on a sunny day and you wanted to be as comfortable as possible, which combination of color and finish on the cube would you want your clothes to be like? Explain.

Real Life Connections

The color of a material clearly has an impact on how much light energy it can absorb. Think about your own experiences and write a paragraph or two about three examples in which you have been affected either positively or negatively by the color of an object and its temperature.

Connections to Capuano

Research how the Capuano School takes advantage of the relationship between color and heat energy transfer. Find at least two examples and explain how the Capuano School uses color and finish to help maintain the building's energy efficiency.