How Hot Is It?

Summary

Heat absorption is compared across white and black paper-lined cups.

Time Frame

1 class periods of 90 minutes each

Group Size

Small Groups

Materials

For the Student: (Groups of 2-3)

- 2 unwaxed paper cups
- 1 sheet black paper
- 1 sheet white paper
- 1 pair scissors
- shoe box
- plastic wrap
- 2 thermometers
- 2 sheets of newspaper
- tape

Background for Teachers

While new energy cannot be created, we can convert one form of energy to another. For instance, through the use of a light bulb, electrical energy is converted into light energy. The chemical energy released through the combustion of wood (burning) is converted to heat as well as the radiant energy (light) of the flame. In this activity, students will examine another form of energy conversion. Here, the radiant energy of sunlight will be converted into heat energy.

Have you ever wondered why people who live in very tropical climates that receive a great deal of sunlight use many bright colors in their homes and clothes? Alternatively, why do the inhabitants of more temperate or cold climates use darker colors in their houses and clothes? This difference can be explained by the physical properties of colors. For instance, black will absorb most of the light rays of the sun, while white will reflect most of the rays of the sun.

What happens as this light energy is absorbed by a material? What does it feel like when you sit in a dark colored car in the summertime? As the light is absorbed, this energy is converted into heat. So darker colored materials feel hotter when exposed to the sun than lighter colored materials.

Intended Learning Outcomes

- Observe simple objects, patterns, and events, and report their observations.
- Use data to construct a reasonable conclusion.
- Record data accurately when given the appropriate form (e.g., table, graph, chart.)
- Predict results of investigations based on prior data.

Instructional Procedures

- Use the black paper to line the inside of one paper cup. Use the scissors to trim as necessary.
- Use the white paper to line the inside of a second paper cup.
- Place the thermometer in each cup. The top of the thermometer will probably extend out of the

top of the cup.
Cover the cups tightly with plastic wrap. Use tape if necessary to secure the wrap around the thermometers.
Place both of the cups in a shoe box so they won't tip over. You may need to crumple some newspaper to hold the energy collectors in place.
Now place the box in the sun.
Observe the thermometers in our energy collectors every 30 minutes for two hours.
Record the temperatures in the form of a graph (time on the horizontal axis, temperature on the vertical axis).
In their groups, have the students answer the following questions and then discuss their ideas as a whole class.
- Which experimental setup got hotter? Why?
- Which experimental setup collected the most energy? How do you know?
- What was the experimental variable in this experiment?
- What is the relationship between color and amount of light energy absorbed?

Extensions

Make sleeves of various colors of construction paper (red, blue, yellow, orange, violet, brown, etc.) Place one thermometer in each sleeve and place in direct sunlight. Check the temperatures at ten minute intervals and have the students record the results.

Assessment Plan

Assess student answers to the questions in #9 to check for understanding that black absorbs heat and white reflects heat.
Based on their experiences during the experiment, have students make predictions for the extension activity.

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