

*In this activity, students participate in an exploration to learn that different colors have varying abilities to absorb solar energy.*

## OVERVIEW

**Topic: Solar Energy**

### Real-World Science Topics:

- The sun is a major source of energy.
- Solar energy is transferred in predictable ways.

### Objective

Students will participate in a hands-on exploration to observe how varying materials absorb solar energy differently.

### Materials Needed for Student Activity

#### Materials Needed for the Grades 2-3 Student Activity:

- 1 square of dark blue construction paper per group (3 x 3 in.)
- 1 square of white construction paper per group (3 x 3 in.)
- 1 square of yellow construction paper per group (3 x 3 in.)
- 1 square of black construction paper per group (3 x 3 in.)
- 1 thermometer per group
- 1 stopwatch per group
- 1 student record sheet per student
- Image of child wearing black t-shirt on sunny day
- 8.5"x11" white sheet of paper in envelope
- Heat lamp if weather does not permit going outside

#### Materials Needed for the Grades K-1 Student Activity:

- 1 square of dark blue construction paper (3 x 3 in.)
- 1 square of white construction paper (3 x 3 in.)
- 1 square of yellow construction paper (3 x 3 in.)
- 1 square of black construction paper (3 x 3 in.)
- 1 thermometer
- 1 stopwatch
- 1 student record sheet per student
- Image of child wearing black t-shirt on sunny day
- 8.5"x11" white sheet of paper in envelope
- Heat lamp if weather does not permit going outside

## Teacher Preparation

Before the activity you should gather all of the activity materials and place them in an area that is easily accessible for students. Additionally, this lesson is dependent upon a warm and sunny spring or summer day. Review the weather forecast and consider using a heat lamp if the weather is not suitable for the activity.

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## Standards Met

### CROSS-CUTTING CONCEPTS

2. *Cause and effect:* Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
5. *Energy and matter:* Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

### CORE AND COMPONENT IDEAS IN THE PHYSICAL SCIENCES

Core Idea PS3.B: Conservation of Energy and Energy

*Sunlight warms Earth's surface.*

- Light also transfers energy from place to place. For example, energy radiated from the sun is transferred to Earth by light. When this light is absorbed, it warms Earth's land, air, and water and facilitates plant growth.
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## Sources

**A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas**

([http://www.nap.edu/catalog.php?record\\_id=13165](http://www.nap.edu/catalog.php?record_id=13165))

**National Science Teachers Association**

<http://books.nap.edu/html/nses/overview.html#content>

- 1. Warm-up Activity:** Ask students to discuss, “How do living things depend on the Sun?” If necessary, explain to them that most living things on Earth rely on the Sun for energy. Plants use energy from the Sun to make food from water and gases in the air. Animals get energy by eating plants or other animals. Ask students if they have ever used energy from the Sun. Chart student ideas.
- 2.** Show a picture of student using magnifying glass to melt or burn something. Ask students if the kid(s) in the image are using energy from the Sun. Post the term solar energy. Explain that solar means Sun and it is a powerful source of energy. Clarify that people have used solar energy for a long time to do things such as cook, dry clothes and remove salt from seawater.
- 3.** Show students a picture of a child in a black t-shirt outside on a hot sunny day. Ask them to describe the weather. Prompt them to look at the child’s clothing, the foliage etc. Tell students they are going to conduct an investigation to figure out which color t-shirt would be best to wear on a hot sunny day.
- 4.** Present the colored squares and review the four color choices. Explain the best color choice for the child would be the color that helps him/her stay cool on a sunny day. Ask students which color they think he/she should use. Chart student ideas.
- 5. Grades 2-3:** Distribute colored squares, thermometers and the Warm Colors handout sheet to the student groups. Explain to students that they are going to conduct an investigation to help them better determine which color the child should choose. Review the steps of the investigation before taking students outside.  
**Grades K-1:** Explain to students that they are going to conduct an investigation to help them better determine which color the child should choose. Review the steps of the investigation before taking students outside.
- 6. Grades 2-3:** Once students are outside have them work together to conduct their trials. Students should record data and use their findings to select the color they think the child should wear.  
**Grades K-1:** Gather materials and take the class outside. Conduct the investigation as a class rotating student volunteers as timekeeper, recorder and data collector. As a class analyze and discuss the data to determine the color they think the child should wear.
- 7. Wrap-up Activity:**  
**2-3** Gather the student groups. Count to three and have each group hold up the color they think the child should wear. Ask students if any of them changed their color selections based on information gathered during the investigation. Prompt students to justify their thinking. After discussing student ideas reveal the best color choice by pulling white paper from the envelope. Discuss as a group why white would be the best choice.  
**K-1** Assign each color a number 1-4 (e.g. 1 dark blue, 2 black, 3 yellow, 4 white). Count to three and have each student hold up the number of fingers that represents the color they think would be best to wear. Ask students if any of them changed their color selections based on information gathered during the investigation. Prompt students to justify their thinking. After discussing student ideas reveal the best color choice by pulling white paper from the envelope. Discuss as a group why white would be the best choice.

## *Warm Colors Extension Activity*

Have each student group place pencils in a cup. Explain to students that their job is to work as a group to answer the question presented. Group members must reach a consensus before removing pencils to record group's response in individual journals. If a group member does not agree evidence must be shared by other group members to try to convince the group member to agree with the majority. Pencils can only be removed when all group members agree.

Present the question, "A soccer team that lives in an area with mostly hot sunny days is trying to determine if they should order navy or yellow jerseys. They want to order the jersey that will help keep them coolest. Which color should they order?" (Option 2: Ski instructors that work at resort with mostly cold sunny days trying to order jackets.)

Have student groups share their responses including evidence to justify their thinking.

### Where does solar energy come from?

Solar energy is actually electromagnetic radiation that is produced by nuclear reactions in the sun's core. The pressure inside the sun's core is very high. The high pressure causes hydrogen atoms to fuse and form atoms of other elements, such as helium. This releases a lot of energy, which eventually makes its way to the surface of the sun. Only about one billionth of the energy that the sun emits reaches earth, but this is still a large amount. Of the solar energy that reaches earth about 25% is reflected by clouds and the atmosphere. 20% more is absorbed by the atmosphere. That leaves about 55% that actually makes it to earth's surface. Most of this is absorbed by the surface, heating the atmosphere and making the planet livable.

### What clothing colors are best for warm days?

Whether you are going outside for a hike or playing on the playground, what you wear can affect your comfort outside on a warm day. Darker colors like black, navy, and charcoal absorb the energy of the sun. Lighter colors like white reflect the energy of the sun. However, color of the fabric is not the only factor to determine when selecting the best clothing to wear on a warm day. The clothing materials also determine your comfort. For instance a black t-shirt is definitely cooler than a white wool sweater.

Name:

Date:

**Procedure:**

1. Fold white paper around the thermometer. After three minutes record the temperature. Shake thermometer and repeat.
2. Fold yellow paper around the thermometer. After three minutes record the temperature. Shake thermometer and repeat.
3. Fold navy blue paper around the thermometer. After three minutes record the temperature. Shake thermometer and repeat.
4. Fold black paper around the thermometer. After three minutes record the temperature. Shake thermometer and repeat.
5. Compare the results. Draw a conclusion.
6. Communicate your results.

Data:

Paper Color	First Trial Temperature After Three Minutes	Second Trial Temperature After Three Minutes
White		
Yellow		
Navy Blue		
Black		

Conclusion:

Which color shirt would be best for the child wear on a hot sunny day? Justify your thinking.