

INTRODUCTION

National Standards

Focus: D2

Related: A1, A2, B2, D3

Category

Earth Science

Focus

Solar Energy

Objective

To explore how color can reflect or absorb sunlight

Overview

Read the overview aloud to your students. The goal is to create an atmosphere of curiosity and inquiry.

Say: *“Some colors reflect light. Some colors absorb light. When the light from the sun is absorbed, it can create heat energy.”*

Simply Solar
Standard D2



FOCUS Solar Energy

OBJECTIVE To explore how color can reflect or absorb sunlight

OVERVIEW Some colors reflect light. Some colors absorb light. When the light from the sun is absorbed, it can create heat energy.

WHAT TO DO
With your team, carefully follow each step below.

Observe
Look at the two tubes. Remove their caps and look inside. Think about how the tubes are similar. Think about how the tubes are different.

Describe
Describe the two tubes. What do they look like?
What do they feel like? What shape are they? How strong are they? What color is each tube?

Discuss
What word can mean “bounce off”? *reflect*
What word can mean “to take in”? *absorb*
What can help reflect or absorb sunlight? *color*

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Additional Comments

To introduce this lesson, ask your students if they’ve ever stepped onto a parking lot barefoot in the middle of the summer. Say, *“Did it burn your feet? Did you quickly jump back onto the grass?”*

Compare the temperature of the soft green grass to the temperature of the hard black parking lot. Discuss a few of the reasons the sur-

face of a lawn might be cooler than the surface of an asphalt parking lot, even though both are in direct sunlight. (differences in color, differences in the materials, differences in the kind of surface, etc.)

Say, *“In this lesson we’re going to explore how one characteristic, color, can make one thing get much hotter than another.”*

ENGAGE - Day 1

What To Do

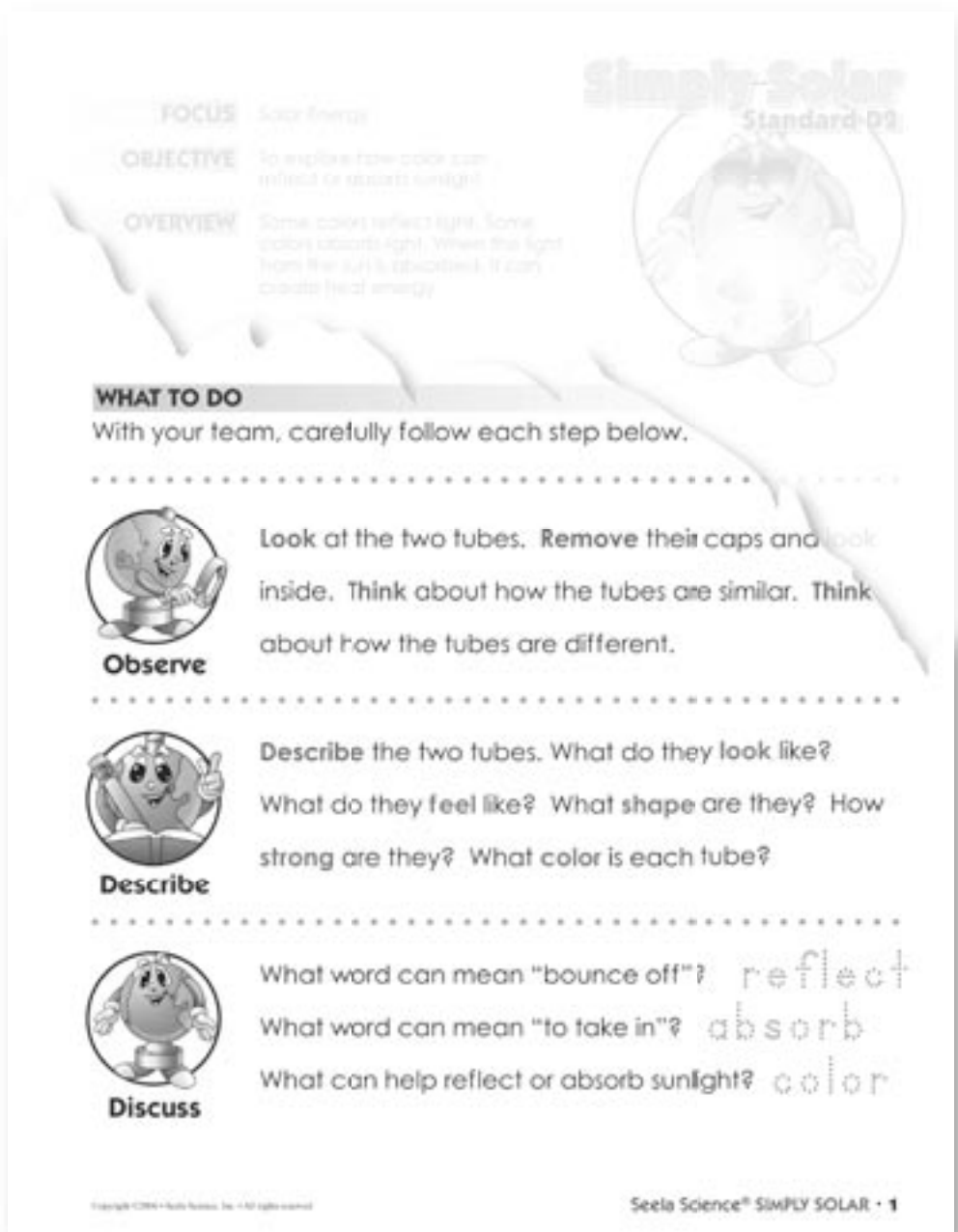
Once students are seated in “research teams” with materials in front of them, read the first section (OBSERVE) aloud.

Say, “To start this lesson, we’re going to **observe** some things. Good scientists always carefully examine the things they will be working with before beginning. First, I will read the instructions to you. Then you can follow the instructions as you **observe** the items in front of you.”

Monitor teams closely as they follow instructions. When teams are finished with this section, repeat the process with the DESCRIBE section. Conclude with the DISCUSS section.

Options

Expand the DISCUSS section, by having students use crayons or markers to write the dotted “key words” on a separate piece of paper. Write the word **reflect** in silver, the word **absorb** in black, and the word **color** using a different color for each letter.



The worksheet is titled "Simply Solar Standard D2" and features a cartoon character of a sun wearing a backpack. It is divided into sections: FOCUS (Solar Energy), OBJECTIVE (To explore how color can reflect or absorb sunlight), and OVERVIEW (Some colors reflect light, some colors absorb light. When the light from the sun's (backpack), it can create heat energy). The main section is "WHAT TO DO" with instructions: "With your team, carefully follow each step below." There are three steps, each with a cartoon character icon and a list of questions:

- Observe:** Look at the two tubes. Remove their caps and look inside. Think about how the tubes are similar. Think about how the tubes are different.
- Describe:** Describe the two tubes. What do they look like? What do they feel like? What shape are they? How strong are they? What color is each tube?
- Discuss:** What word can mean "bounce off"? *reflect*
What word can mean "to take in"? *absorb*
What can help reflect or absorb sunlight? *color*

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Teacher to Teacher

Here’s an opportunity to clear up a common misconception.

Since there’s 93 million miles of freezingly cold space between the Earth and Sun, we don’t actually get HEAT from the Sun.

What really happens is that the LIGHT from the Sun passes through our atmosphere and hits

things. As this light is absorbed, it is changed into heat.

How much heat an object absorbs (and releases) depends on factors like color, composition, air flow, etc. Park a car with dark leather seats in direct sunlight — even on a cool day — and you’ll quickly discover how extremely efficient some combinations can be!



READ THE STORY

Some colors reflect light. Some colors absorb light. Read the story below to find out what happens when sunlight strikes different colors.

Solar Energy

Scientists call energy from the Sun "solar energy". Solar energy is created by sunlight. When sunlight is absorbed, it can create heat (one form of energy). An object's color can affect how much light it absorbs.



Light can create heat.

Heat can *not* travel through space. Even though the Sun is very hot, it is too far away for its heat to affect Earth. The heat of the Sun can not reach us.

But light can travel through space. Light from the Sun travels through space to strike the Earth. This light is absorbed by many objects on Earth.



Colors absorb or reflect light.

Dark colors can absorb sunlight. Dark, dull colors (like flat black) can absorb light. When sunlight is absorbed, it can create heat, making an object hot.

Light colors can reflect sunlight. Light, shiny colors (like glossy white) reflect light. When sunlight is reflected, it can keep an object from getting hot.



Colors can affect comfort.

A white shirt can help keep you cool. Since white reflects sunlight, a white shirt keeps you cooler if you're in the sun. Many people wear white clothes in summer.

A black shirt can help keep you warm. Since black absorbs sunlight, a black shirt can be warmer than a white shirt. Many people prefer dark clothes in the fall.

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WHAT I LEARNED - part 1

Discuss the story (page 2), then answer the questions below.

- 1 How can a dark color make something hot?

- 2 How are black and white alike? How are they different?

- 3 Which might be cooler — a yellow shirt or a blue one? Why?

WHAT I LEARNED - part 2

Discuss the activity (page 4), then answer the questions below.

- 1 Where did the energy for this activity come from?

- 2 How were the two tubes alike? How were they different?

- 3 Which might be hotter inside — a black car or a white car? Why?

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INFORM - Day 2

Read The Story

Read the story aloud with your students. (Suggested adjustments for reading levels can be found in the RESOURCE BINDER on page 8.) After reading, monitor teams as they discuss what was read. Once you feel students have mastered the basic concepts, have them answer the comprehension questions (**What I Learned - part 1**).

To introduce the story, say:

"The title of this story is 'Solar Energy.' Look at your story and follow along as we read it together."

What I Learned (part 1)

These are basic fact-based comprehension questions. Student answers will vary but suggested responses include:

- 1 Dark colors absorb light. When light is absorbed, it is changed into heat.
- 2 a) both are colors b) black absorbs light; white reflects light
- 3 a) light yellow b) yellow is a much lighter color than dark blue, so it would reflect more light

Field Trip

Visit a greenhouse to find out the tricks they use to wring all the heat they can from sunlight and how they cool the greenhouse quickly on a day that's too sunny.

Guest Speaker

Invite a builder of energy-efficient homes, or a resident of a "solar home" to visit your class. Ask him/her to talk about ways the Sun can help reduce home energy costs.

EXPLORE - Day 3

Materials Needed*

black tube with lid water
clear tube with lid
white construction paper

Safety Concerns

4. Slipping

There is a potential for spilled liquids. Remind students to exercise caution.

4. Other

Remind students to never look directly at the Sun!

Do the Activity

Read the activity in advance so you understand it thoroughly. (If time allows, try it yourself.) Before students begin, carefully go over the **Safety Concerns** together.

Pass out materials, then have your students follow along as you read the instructions for **Step 1**. Monitor teams closely as they complete this step.

Once teams have completed **Step 1**, read instructions for **Step 2**. Monitor teams as before. Repeat for **Step 3** and **Step 4**.

After the activity, allow time for each team to share their observations. To encourage higher-level thinking, encourage teams to not only share their observations with each other, but also with other teams.

Special Instructions

Step 1 - A paper cup (pinched to make a spout) may make pouring easier. You may substitute the phrase “finger width” for the “half inch” instruction if desired.

Step 2 - This Step requires a sunny, protected location. A wide windowsill works great. Be sure the tubes are in direct sunlight (not just a bright spot)!

Step 3 - Remind students to remove the caps carefully to avoid spilling water.

Step 4 - Temperature variations may be minimal if air is cool or clouds interfere.

DO THE ACTIVITY
Working with your research team, carefully follow each step below. Before you start, be sure you know the safety rules for this activity.

STEP 1
Fill the black tube almost full of water. (Leave about a half inch of air at the top.) Replace the cap and tighten it. Repeat with the clear tube.

STEP 2
Place one sheet of white construction paper in the direct sun. Lay both tubes on the paper as shown. Leave the tubes in the sun for at least two hours.

STEP 3
Touch a finger to the water in the clear tube to test its temperature. Repeat using the black tube. Make sure everyone on your team has a turn.

STEP 4
Discuss your findings. What was the only variable (difference) between the tubes? Compare your observations with those of other research teams.

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What Happened?

Immediately following the activity, help your students understand what they observed.

Say: “*In this activity, you explored how color can reflect or absorb sunlight, resulting in heat.*”

In Step 1, you filled two tubes with water, and you observed that the only difference between the tubes was that they were different colors.

In Step 2, you exposed the tubes to direct sunlight for a period of time.

In Step 3, you tested the difference in heat absorbed by each tube. You discovered that dark colors absorb more light than light colors, resulting in more heat.


Finally in Step 4, you shared and compared findings with those of other research teams.”


* *Bold-faced items supplied in kit.*

NAME _____

Show What You Know 1

Circle the objects that should absorb sunlight with red.
Circle the objects that should reflect sunlight with blue.
Write the correct names on the lines below.

Light objects _____ sunlight.

Dark objects _____ sunlight.

To the Parent . . .

Lesson Focus:
Solar Energy

Lesson Objectives:
To explain how color helps change sunlight into heat.

National Science Education Standards:
Standard E2 – "All students should develop an understanding of objects in the sky . . . the sun, moon, stars . . . the sun provides the light and heat necessary to maintain the temperature of the earth . . ."

Follow-up Questions:
Ask your child how sunlight might affect a dull, black car (would absorb, might make it hotter, etc.).
Ask your child how sunlight might affect a shiny white car (would reflect, might make it cooler, etc.).
Ask your child why people prefer white or light-colored clothes in the summer (reflect sunlight, making them cooler).

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EXPAND - Day 4

Begin **Day 4** with a review of **Day 3**, then have students answer “part 2” questions.

What I Learned (part 1)

These are higher-level cognitive questions (explain, compare, predict). Student answers will vary but suggested responses may include:

- 1) light from the Sun
- 2) a) same size, same shape, same contents, etc. b) one black, one white
- 3) a) black car b) because black absorbs heat (or white reflects heat)

ASSESS - Day 5

Suggestions for modifying assessments to reflect reading levels can be found in the **RESOURCE BINDER** on page 10.

Show What You Know 1

Answer Key (general assessment):

Blanks - reflect, absorb. Also the shirt and road should be circled in red; the car and roof should be circled in blue.

Show What You Know 2

Answer key (optional Fluent Reader test):

- 1) T 2) F 3) F 4) T 5) T

To The Parent

Included at the bottom of all assessment tests “To The Parent” provides a great way to solicit parent involvement. It not only gives parents an overview of the lesson, but also provides follow-up questions for home use.

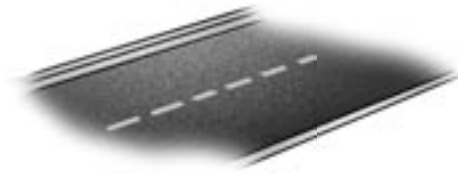
Extended Teaching

1. To expand vocabulary, talk about “energy” as the capacity to do work. Solar energy (energy from the Sun) can be used for heating, generating electricity, and cooking. Scientists are constantly searching for new ways to harness the endless power of the Sun.
2. Encourage students to use the Internet to find out more about solar energy, solar houses, and ways of trapping solar energy.
3. Challenge students to wear different colored clothes to find out how color can affect comfort. Ask, “*Why do people usually wear light-colored clothes in the summer and darker clothes in the winter?*”
4. If your class is more advanced, challenge student research teams to paint the tubes from this activity with other colors (yellow, dark blue, etc.) and finishes (flat to glossy), then repeat the activity, recording how color and surface affect the efficiency of light’s conversion to heat.



Show What You Know 1

Circle the objects that should **absorb** sunlight with red.
Circle the objects that should **reflect** sunlight with blue.
Write the correct names on the lines below.



Light objects _____ sunlight.

Dark objects _____ sunlight.

To the Parent . . .

Lesson Focus:

Solar Energy

Lesson Objective:

To explore how color helps change sunlight into heat .

National Science Education Standards:

Standard D2 — “All students should develop an understanding of objects in the sky . . . the sun, moon, stars . . . the sun provides the light and heat necessary to maintain the temperature of the earth . . .”

Follow-up Questions:

- Ask your child how sunlight might affect a dull, black car (would absorb, might make it hotter, etc.).
- Ask your child how sunlight might affect a shiny white car (would reflect, might make it cooler, etc.).
- Ask your child why people prefer white or light-colored clothes in the summer (reflect sunlight, making them cooler).



Show What You Know 2

Read each sentence below. If the sentence is true, circle the letter **T**. If the sentence is false, circle the letter **F**.

T F 1. Energy that comes from the Sun is called “solar” energy.

T F 2. Dark colors reflect sunlight. This makes objects hot.

T F 3. Light colors absorb sunlight. This keeps object cool.

T F 4. Wearing white in the summer might keep you cooler.

T F 5. Light from the Sun can be absorbed, resulting in heat.

To the Parent . . .

Lesson Focus:

Solar Energy

Lesson Objective:

To explore how color helps change sunlight into heat .

National Science Education Standards:

Standard D2 — “All students should develop an understanding of objects in the sky . . . the sun, moon, stars . . . the sun provides the light and heat necessary to maintain the temperature of the earth . . .”

Follow-up Questions:

Ask your child how sunlight might affect a dull, black car (would absorb, might make it hotter, etc.).

Ask your child how sunlight might affect a shiny white car (would reflect, might make it cooler, etc.).

Ask your child why people prefer white or light-colored clothes in the summer (reflect sunlight, making them cooler).