

LESSON PLAN

# Soak Up the Sun with Solar Energy Fun

Grades 2 & 4



## SUMMARY

This lesson will introduce students to solar energy – energy that is produced by the sun – and the advantages and disadvantages of solar energy.



## ESSENTIAL QUESTIONS

1. How can solar energy produce heat and electricity?
2. What are the advantages and disadvantages of solar energy?



## LESSON OBJECTIVES

Upon completing this lesson, the students will be able to:

- Describe various ways that solar energy can be used; and
- Describe the advantages and disadvantages of using solar energy.



## DURATION

The activity requires 50 to 60 minutes or two class periods.



## COLLEGE & CAREER-READY SCIENCE STANDARDS 2021

### GRADE 2

STANDARD

**2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.**

DISCIPLINARY CORE IDEA (DCI)

**PS1.A: Structure and Properties of Matter**

Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

CROSS-CUTTING CONCEPTS (CCC)

**Patterns**

Patterns in the natural and human designed world can be observed.

STANDARD

**2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.**

DISCIPLINARY CORE IDEA (DCI)

**PS1.B: Chemical Reactions**

Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

CROSS-CUTTING CONCEPTS (CCC)

**Cause and Effect**

Events have causes that generate observable patterns.

## GRADE 4

STANDARD	STANDARD
<b>4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</b>	<b>4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.</b>
DISCIPLINARY CORE IDEA (DCI)	DISCIPLINARY CORE IDEA (DCI)
<p><b>PS3.B: Conservation of Energy and Energy Transfer</b></p> <p>Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.</p> <p>Light also transfers energy from place to place.</p> <p>Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.</p>	<p><b>PS3.D: Energy in Chemical Processes and Everyday Life</b></p> <p>The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.</p>
CROSS-CUTTING CONCEPTS (CCC)	CROSS-CUTTING CONCEPTS (CCC)
<p><b>Energy and Matter</b></p> <p>Energy can be transferred in various ways and between objects.</p>	<p><b>Energy and Matter</b></p> <p>Energy can be transferred in various ways and between objects</p>

## ENGAGE

Set up this scenario for your students. Have them imagine they are planning a trip to a very sunny destination. You may want to brainstorm a few sunny places that could be (the beaches, Florida, etc.). In this scenario, the last time they took a trip to this sunny destination they ended up with a very bad sunburn. They don't want to make that same mistake again. So they need to find a good sunscreen to keep from getting another painful sunburn. Show the students the solar beads (that have not changed color). Discuss ideas on how these beads may help in making a decision about using sunscreens.

## EXPLORE

Using the solar beads, a zip-lock bag, and different sunscreens, make the best decision on how to avoid the harmful rays from the sun. Follow this procedure.

1. Put the students into pairs.
2. Give each pair some sunscreen (it doesn't matter what SPF at this point), two zipper-locked bags, and beads (one set per student, if able).
3. Send them to the windows, outside, or wherever your sunlight source is.
4. Allow them to experiment with the materials.
5. Ask guiding questions as they explore the materials.
  - What happens to the beads when they are in the light?
  - How can using the beads help them choose an acceptable sunscreen?

Have the students develop a plan to investigate how sunscreen provides protection from the sun. The students should:

- write the plan in their Science journals/notebooks to document the process they will follow to test the beads with sunscreen as a way of emphasizing the science and engineering practices.
- Put the beads in the zipper-locked bag and cover the bag on the outside with sunscreen.
- Observe what happens to the color of the beads with the sunscreen on the bag and without the sunscreen on the bag.

Ask students if they observed a color change? If they answer yes, ask them to construct an explanation about why some beads changed color in the bag and some did not.

Lead students in a discussion about factors that could impact the effective use of sunscreen lotion (for example,

uneven application of sunscreen lotion to the bag or perhaps they observed certain color beads responded better or worse when the sunscreen was added to the outside of the bag).]

6. After the students have had 10 minutes to experiment, bring them back together to discuss what they observed. Explain to the students that the beads are UV-sensitive beads, which means they absorb the rays from the sun. Their color changes depending on how much light they are absorbing. The sun's rays can be absorbed and reflected.

When you use sunscreen, the lotion allows your skin to absorb some sun rays, but it also reflects some rays away from your skin. That's why wearing sunscreen helps keep you from getting a sunburn.

As a class, develop a list of possible ways these beads could be used to promote awareness around sun safety and skin cancer prevention in their school.

This activity can also be done as a teacher demonstration in lieu of a student activity if presented with time, material, or other constraints.

## EXPLAIN

Watch the video called **Solar Power** from NOVA PBS at [youtu.be/m74bMrxBkw](https://youtu.be/m74bMrxBkw).

In this video, the students will learn the amount of solar energy that strikes the surface of the Earth in one hour is more than enough to supply every person on the planet with electricity for an entire year. However, there are limits that prevent us from being able to fully take advantage of this energy. While the students are watching this video, have them take notes to answer these guiding questions.

1. Describe two ways solar energy can be used.
2. Describe one advantage and one disadvantage of solar energy.

## MATERIALS

- UV Solar Beads (Steve Spangler Science)
- Clear Zipper-Lock Bags
- Sunscreen
- Clear Cups
- Thermometer
- Black Construction Paper
- White Construction Paper
- Water
- Clear Plastic Wrap

**Please be aware that this activity contains the use of sunscreen lotion.** Make your students aware that sunscreen lotion may stain clothing or irritate eyes/skin.

The S.C. Energy Office (SCEO) may have certain materials for this lesson available for teachers to use. Contact Stacey Washington the SCEO at [swashington@ors.sc.gov](mailto:swashington@ors.sc.gov) to check for availability.



## ELABORATE



Heating with solar energy is not as easy as you might think. Capturing sunlight and putting it to work is difficult because the solar energy that reaches the earth is spread out over a large area. The amount of solar energy an area receives depends on the time of day, the season of the year, the cloudiness of the sky, and how close you are to the earth's equator.

A solar collector is one way to capture sunlight and change it into usable heat energy. A closed car on a sunny day is like a solar collector. As sunlight passes through the car's windows, it is absorbed by the seat covers, walls, and floor of the car. The absorbed energy changes into heat. The car's windows let radiant energy in, but they don't let all the heat out. Share with the students that there are two types of solar collector technologies available: 1) solar thermal energy (STE) and 2) photovoltaic solar (PV).

How does solar thermal energy work? Remind the students about the conservation of energy. Solar thermal energy systems convert the sun into heat (thermal). It does this by letting the sun heat the solar collector or panel. This in turn, heats water or fluid and is either pumped or moved by convection, as in the case of some solar pool heaters, then circulates the water or fluid through the system.

Photovoltaic solar (PV) converts sunlight into electricity for any building (solar panels). A photovoltaic system actually produces electricity for any electrical use, from powering appliances to running an air conditioning unit. A photovoltaic solar system will allow a home or building to produce electricity for its own consumption and in some cases sell it back to a utility company. Simply stated, photovoltaic power systems convert the sun's energy into electricity.

Conduct the SOLAR COLLECTION INVESTIGATION and use the Student Worksheet on the following page. Have

students share their data with the class. Ask students what they observed about this temperature data? Have students identify any patterns they observed in the data shared and/or construct explanations to explain what the data showed.



## EVALUATE

Have the students generate a written or video response to the following questions:

1. Describe solar energy and how it is used.
2. Describe benefits and disadvantages of solar energy.
3. Do you think that the sun's light or heat is most important? Explain your reasoning.
4. Make and defend a claim either for or against this statement: **"Solar energy is a reasonable alternative energy source."** Provide evidence to support your claim.



## E-LEARNING ACTIVITY

- The ELABORATE activity from this lesson can be adapted as a virtual demonstration for students.
- The EVALUATE section of this lesson also can be used for virtual learning.
- This Webquest activity below can be used as an additional evaluation tool or a replacement for the ELABORATE activity.

### SOLAR ENERGY WEBQUEST

[www.eia.gov/kids/energy.cfm?page=solar\\_home-basics](http://www.eia.gov/kids/energy.cfm?page=solar_home-basics)

1. **What is solar energy?**
2. **Solar energy is converted into what energy?**
3. **Give two examples of how solar energy is used.**
4. **What do solar cells do?**
5. **What do solar power plants do?**
6. **What are the two main disadvantages of solar energy?**
7. **Explain how solar energy is beneficial for the environment.**

Installing solar panels on homes has become a popular way for South Carolina residents to reduce their energy costs.



# SOLAR COLLECTION INVESTIGATION

The purpose of this investigation is to explore solar collection.

- **STEP 1:** Cut two circles each of white and black construction paper 5 cm in diameter. Place the circles in the bottoms of four plastic containers and cover with 40 ml of cold water. Record the temperature of the water.
- **STEP 2:** Cover one black and one white container with clear plastic wrap, held in place with rubber bands.
- **STEP 3:** Place the containers in a sunny place so that the sun is directly over them. Predict what will happen. Record the temperature of the water after 5 and 10 minutes.
- **STEP 4:** Calculate and record the changes in temperature.

## RECORD THE DATA

	WHITE NO COVER	BLACK NO COVER	WHITE WITH COVER	BLACK WITH COVER
Original Temperature				
Temperature After 5 Minutes				
Temperature After 10 Minutes				
Temperature Change in 5 Minutes				
Temperature Change in 10 Minutes				