

# Teacher Instructions

## Lesson Three: How Shadows Indicate the Sun's Strength

**Objective** Students will learn how shadow lengths vary at different times of the day and indicate when the sun's rays are most harmful.

**Materials** Copies of the "Shadow Observations" student activity sheet; yardsticks, rulers, yarn or string for measuring shadows; tape; access to an outdoor area before 10 a.m. and again between 12 p.m. and 4 p.m.; sidewalk chalk

### Planning for the Experiment

Determine the following before beginning the experiment:

1. Pair each student with a partner or have them work in small teams.
2. Find a safe area outdoors where you will have students measure their shadows.
3. Select a time before 10 a.m. and another time between 12 p.m. and 4 p.m. to take the measurements.
4. Decide how students will measure their shadows. If students use rulers only, they should mark the place where they stand with chalk and have their partners mark the top of their shadow with a chalk mark. They will then use rulers to measure the distance between chalk marks. If using string or yarn, give each student a long piece of string or yarn and two pieces of tape. The student creating the shadow will tape one end of the string where he or she is standing, while their partner will tape the string or yarn at the other end of the shadow. They will then measure the distance between tape marks.
5. Look up the UV Index number on the day of the experiment to share with students.

### Getting Started

1. Ask students to recap what they've learned about when the sun's rays are most harmful. Remind them that the sun's rays are most harmful when the sun is high in the sky and directly overhead, between 10 a.m. and 4 p.m.
2. Next ask them what they observed about shadows when they were outside.
3. Explain that you're going to do an experiment to observe how shadows appear at different times of the day and the connection between shadow length and the strength of the sun's rays.
4. Follow all sun safety precautions before going outdoors.

### Using the Activity Sheet

1. Distribute copies of the "Shadow Observations" student activity sheet and review it with students.
2. Assist students with measuring their heights. Have them record their height and complete the first five columns of the chart.
3. Take students outdoors to view and measure their shadows.
4. Explain how students will mark and measure their shadows.
5. Have students complete their charts, including their observations and explanations.
6. Review the results. Explain to students that the lengths of their shadows can determine when sun rays are most harmful. During early morning and late afternoon, shadows are longer. During the midday hours (10 a.m. to 4 p.m.), the sun is directly overhead and shadows are shorter (or there is no shadow). The sun's rays are more intense and harmful at this time.

7. Remind students that it is important to be extra protected if they plan to be outside during midday hours; they should use as many forms of sun protection as possible. Review sun safety tips (e.g., sunscreen, protective clothing, wide-brimmed hats, sunglasses, and shade).

**Follow-up Activity** To further explore how powerful the sun's rays are, create a solar-powered oven with your class. While this is a positive use of the sun's energy, it also demonstrates the sun's strength. Check out the example at [climatekids.nasa.gov/smores](http://climatekids.nasa.gov/smores).

## Lesson Four: Building a 3-D Model of the Skin

**Objective** Students will be guided to make 3-D models of the skin. This will provide a better understanding of the skin's layers, the difference between healthy and damaged skin, and how UV rays penetrate the skin.

**Materials** Copies of the "3-D Skin Model Project" student activity sheet.

**Suggested Model Materials** Tissue box, toothpicks, pipe cleaner, cotton balls, plastic wrap

### Getting Started

1. As a class, review the "What Is Skin?" lesson. Ask students to recap what they learned and prompt responses that start a discussion about the layers of the skin and what they do.
2. Review UV rays and the different types, specifically how UVA and UVB rays impact the skin.

### Planning for the Project

1. Explain to students that they will be creating 3-D models of the skin and distribute copies of the "3-D Skin Model Project" activity sheet.
2. As a class, brainstorm materials that could be used to build skin models and write the list on the board.
3. Divide students into groups of four. In each group, each pair will work on two versions of the model: One pair will produce a model of healthy skin and one pair will produce a model of sunburned skin.
4. Have students sketch their model designs and make a list of which materials they will use. Tell students to bring items they don't have in class from home on the day of the project.

### Project Day

Student groups will build their designs ensuring each model is labeled accurately and shows how UV rays penetrate the skin.

**5th-Grade Extension** Have students write an accompanying report about what the skin does, how the sun can affect the skin, and how we can stay healthy by protecting our skin. Students can also research other elements of the skin, such as blood vessels and hair follicles, to build on their models.

**Follow-Up Activity** Have students spread the message of sun safety with schoolmates, family, and friends by becoming sun safety ambassadors! Students can design sun safety message cards to distribute at home or with other classes at school. You can also create a display on a hallway bulletin board.

### Complete the Unit

Copy and distribute the "What Do You Know About Sun Safety?" post-assessment sheet to find out what your students have learned. Submit your students' assessments and you could win \$500!