

## Lesson K 1.6 – Designing a Shade Structure

### Objective

Students will design and build a structure that can block the sun to create a shaded area and will test to see if the shady spot is cooler.

### Key Concepts

- Sunlight warms the Earth’s surface.
- Certain structures are designed to block the sun’s light to create shade and reduce the warming effect of the sun.
- Designing and building a structure to shade an area from the sun takes planning, testing, and possibly changing the structure until it works best.

### NGSS Alignment

- **K-PS3-1 Make observations to determine the effect of sunlight on Earth’s surface.**
- **K-PS3-2 Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.** (This performance expectation integrates traditional science content with engineering through a practice or disciplinary core idea.)

### Summary

- As a class, students go outside on a sunny day and go under a tree or in the shadow of the school building to get in the shade. Students should feel that it is cooler in the shade than in the sun.
- Students look at pictures of structures designed to block the sun to make shade.
- Students design and build a small structure to provide shade and then test whether their structure helps keep a surface cooler than the same surface exposed to the sun.

### Evaluation

There is no formal student activity sheet or assessment for this lesson. To evaluate student understanding, use your usual methods of interacting with students, asking questions, and discussing ideas with students as they participate in the different parts of the lesson.

### Safety

No special safety precautions are necessary.

### Materials for each group

- Construction paper
- Paper towels
- Pipe cleaners
- Popsicle sticks
- Straws
- Tape
- 2 small paper or plastic plates
- 2 small student thermometers

## ENGAGE

### 1. Bring students outside to feel the warmth of the sun and the cooler shade.

Bring students outside on a warm sunny day. Pick a location where students can easily move between the sun and an area of shade.

Point out the difference between the warmth of the sun and the cooler shady spot.

Have a discussion about how the sunlight can be blocked by a tree or a building or other structure to create shade, and that an area with less direct sunlight feels cooler.



### 2. Back in the classroom, show students [pictures of different structures](#) used to create shade.



Discuss with students how the size and shape of a structure helps to make different areas and shapes of shade. You might briefly discuss how some structures block the sunlight from the top only, while other structures may also block it from the side. Some structures, like large patio umbrellas, are made so they can be tilted at an angle to block the sun as the sun changes position in the sky during the day.

## EXPLORE

### 3. Have students design and draw plans for a small structure to provide shade to an area big enough for a student's hand.

#### Question to investigate:

Can you design and build a structure to create a shaded area that keeps the temperature of the area lower?

Show students the materials they have to work with.

#### Materials for each group

- Construction paper
- Paper towels
- Pipe cleaners
- Popsicle sticks
- Straws
- Tape
- 2 small paper or plastic plates
- 2 small student thermometers

Explain to students that they should work with a partner to build a structure that will shade an area big enough for their whole hand to be in shade. Help students begin to imagine what their structures could look like. Refer students to pictures of shade structures they have seen and to the different materials they have available.

**Note:** It may be helpful to make a structure that shades a pretty large area. Taping four pieces of paper together to make a large canopy or tent may be more effective than using a single sheet. You also may need to leave the structure in place for more than 15 minutes to observe or feel any perceptible cooling effect.

Have students draw what they think their shade structure should look like and ask students to label the different parts of the structure showing what materials they will use.

#### 4. Review student plans and guide students to build their structures.

Go around the room and look at different student plans. Remind students of the materials available, suggest ideas if the students seem stuck, and help them draw what their structures might look like.

Help students build their structures.



#### 5. As a class, decide how to test whether the structure actually makes the shaded area cooler than a sunny spot next to it.

**Note:** Students may suggest methods of testing that sound like they may work, but depending on the outside temperature, and how long the structure creates the shade, it is not always easy to observe difference between the temperature of the shady spot and the sunny spot.

Students may suggest placing their structure in the sun and then putting one hand in the shade and one hand in the sun next to their structure. This may work if the outside temperature is warm enough to feel the difference.

Another possibility could be putting a thermometer in the shady spot and a thermometer in a sunny spot next to it. But if you use thermometers, place each on a small upside-down paper or plastic plate to lift them off the hot cement, stone, asphalt, or other surface because the hot surface will heat the thermometer that is in the shade and affect the experiment.



Student designs and structures should be considered successful if they create an area of shade even if no cooling effect can be detected. Designing and building a structure to address a problem is a valid learning goal.

## EXPLAIN

6. Show an animation to help explain that in order to cast a shadow and cool an area, a structure needs to be made from the right material, be the right size, and at the right position and angle.

Show the animation [Made for Shade](#)



To make a structure that blocks the sun and makes the right size shadow, the structure needs to be made of the right kind of material, be the right size, be placed in the right spot, and angled in the right way.

## EXTEND

7. Show [illustrations of other ways to block the sun](#) and why we do it.

Building a structure to block the sun creates shade and makes the temperature cooler. But there are other ways to block the sun for different reasons.



Instead of building a structure to protect an area from the sun, you can put a “structure” on your head. A hat with a big brim helps protect people from the sun.

Sunscreen doesn't block the sun's heat but it does block the effect of some of the sun's light and helps protect people from getting sunburn.

Sunglasses block some of the sun's heat but they block a lot of the sun's light and help protect peoples' eyes. Sunglasses also reduce glare and make it easier to see.