

Shadows

How does the sun change the shadow of a building throughout the day?

Theme

This lesson encourages students to notice shadows made by buildings and to observe how these shadows look different at various times in the day. Using their imaginations, students will add unique paper shapes to a box to cast interesting shadows.

Student Objectives

- create and observe human-made shadows
- describe the relationship between the position of the sun and the shape and movement of a building's shadow
- cut out and glue paper shapes on a box, then record the interesting shadows created

Activities

- play with shadows
- record shadows of buildings at different times of the day or year
- make box models of buildings that will cast interesting shadows

Type

- indoor, classroom activities
- outdoor, playground activities

Timeframe

three class sessions of 40 minutes each

Materials

- direct sunlight for Day One and Day Two
- **Handouts A and B** - photographs of interesting shadows found in the city
- sidewalk chalk (*one piece per student*)
- 3–4 foot piece of string or a craft stick (*one per student*)
- several flashlights for student use
- large sheets of drawing paper and black crayons
- small boxes, approximately shoebox size (*one per student or small student group*)
- stiff paper to decorate and add interesting shapes to box models of buildings
- scissors and glue

Teacher Prep

- wait for a sunny day to do Day One and Day Two
- gather small boxes, or have students bring boxes from home
- photocopy or scan **Handouts A and B** for display or projection



Vocabulary

shadow the darkness created when something such as a building or a person blocks the sunlight

sunlight light from the sun that shines directly onto something

temperature the way we measure heat and cold

Background Information for Teacher

Giving students time to play and experiment with shadows challenges what young children know about the sun, shapes, and the space around buildings.

Basic ideas for your students: the sun is highest in the sky at noon, and lowest in the eastern sky near sunrise and in the western sky near sunset.

For more photographs showing how buildings create shadows, see the Eighth grade lesson for Mathematics.



Discussion Points

- What are shadows?
- How can you make a shadow?
- What changes how shadows look? (only the shape of the object, not the original color of the object)
- Can shadows be different colors?
- Does the shadow of a building move and change throughout the day? What do you think is the cause of this?
- Why are shadows long sometimes and short at other times?
- Where do shadows go at night?
- Do you feel hotter or colder when you stand in a shadow?
- What time of year would you want to be standing in a shadow? (on a hot summer day)
- What time of year would you not want to be standing in a shadow? (on a cold winter day)
- Does the sun shine directly in your classroom windows? Do you want to have sun shining directly in your windows? Why or why not?
- What are some ways that we try to block the sunlight from coming in our windows?

Activity Procedures

DAY ONE

Suggested activities for playing and experimenting with shadows outside

- 1** Take your class outside to the playground and give each student a piece of chalk. In pairs, have them draw around each other's shadows. Can they make their shadow people stand on one another's heads? (Give them time to explore this process, as it may be harder than it seems.)
- 2** Draw several small circles on the ground in chalk. Have students try to "touch" the spot with their shadow hands from different heights, locations, and positions.
- 3** Have students stand "inside" a shadow of the school building and stick their hands or feet into the sunlight to create a shadow on the ground. Let another student trace around these people-parts and building shadows.
- 4** Play a game of shadow tag on the playground.
- 5** Once back in the classroom, review shadow shapes with the photographs from **Handouts A and B**. Have students guess what object created each shadow.

DAY TWO

Low sun in the morning and evening versus high sun in the afternoon - Recording building shadows and watching as the shadows move

- 6** Ask students the following starter questions: When you sit in your desk, can you see the sun? Where is it in the sky? Where is the sun in the sky when you arrive at school in the morning? Where is the sun in the sky at lunchtime? Where is the sun in the sky when you are getting ready to go home in the afternoon?
- 7** Bring your class into a room where direct sunlight comes in through the window. Place an "X" of masking tape on the window. Put a piece of white paper on the wall or floor where the shadow of the "X" is cast and mark that shadow with a crayon. Every few minutes, follow the movement of the "X" and mark the new spot, adding more sheets of paper as needed. Talk about why the students think the "X" keeps moving.

8 Take your class outside to the playground and give each student a piece of chalk. (If the shadows of your school fall on grass instead of pavement, give each student a 3–4 foot piece of string or a craft stick. Have students mark the edge of the building's shadow with chalk, string, or the craft stick to see how the shadow moves. The movement may surprise students who have never stopped to observe that the sun moves in our sky. Will the shadow of the building ever move back to where the original mark was? Talk about where the sun is in the sky at that moment. *(It is true, of course, that the earth moves around the sun. You may choose to handle this scientific concept in whatever way you feel appropriate for your students.)*

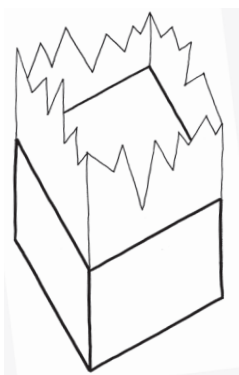
9 At a different time of day, bring the class back outside to the same spot where the building's shadow was marked. Where is the shadow now? Is the shape of the shadow the same as it was? What is the shape of the shadow now? Where is the sun in the sky? **Important:** Reinforce the students' observations by discussing how the sun is low in the sky in the morning and evening and highest in the sky around noon.

DAY THREE

Adding shapes to box models to cast interesting shadows

10 Have students work individually with a small box or in small groups with a larger box that represents a building. Provide stiff paper, scissors, and glue. The task for the students is to cut out interesting shapes and glue them to the edge of their "building." The paper being glued on must stick out from the edges of the box. Remind students that shadows are always black, no matter what the color of the building, so the color of the paper does not matter.

11 Create and record a shadow. Distribute a large sheet of drawing paper and a flashlight to each small group of students. Have students place their models on the paper on the ground and trace around the perimeter. Then, with models still in place, have one partner cast a shadow by holding a flashlight several feet above the model so the other partner can trace around the shadow created by the model. Students can color in the shadow with a black crayon.



box with interesting shapes glued onto it



plan of box shadow of box

Encourage students to move the flashlight low and high and to trace the positions of several different shadows, imitating early morning or mid-afternoon sun. How do the shadows change as the flashlight is moved around?

Students may also experiment by adding new shapes to their building. Some may discover that cutting holes in their model also creates interesting shadows.



Interdisciplinary Connection

Mathematics

Take a math shadow walk around the block with your class. Bring along a tape measure, a clipboard, and some paper to record information. What is the longest shadow your students can find? How long is it? What building made this shadow? What time of day did they find this shadow? What is the shortest shadow your students can find? How short is it? What building made this shadow? What time of day did they find this shadow? Graph the results.



Resources

Guess Whose Shadow?, Stephen R. Swinburne. Honesdale, PA: Boyds Mill Press, 1999.

Moonbear's Shadow, Frank Asch. Englewood Cliffs, NJ: Prentice-Hall, 1985.

My Shadow, Robert Louis Stevenson, Glenna Lang, illust. Boston: Godine, 1989.

Nothing Sticks Like a Shadow, Ann Tompert, Lynn Munsinger, illust. Boston: Houghton Mifflin, 1984.

What Makes a Shadow?, rev. ed., Clyde Robert Bulla, June Otani, illust. New York: HarperCollins, 1994.

Illinois Learning Standards and Benchmarks

12C Know and apply concepts that describe properties of matter and energy and the interactions between them.

12.C.1a Identify and compare sources of energy.

12.C.1b Compare large-scale physical properties of matter.

12F Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.

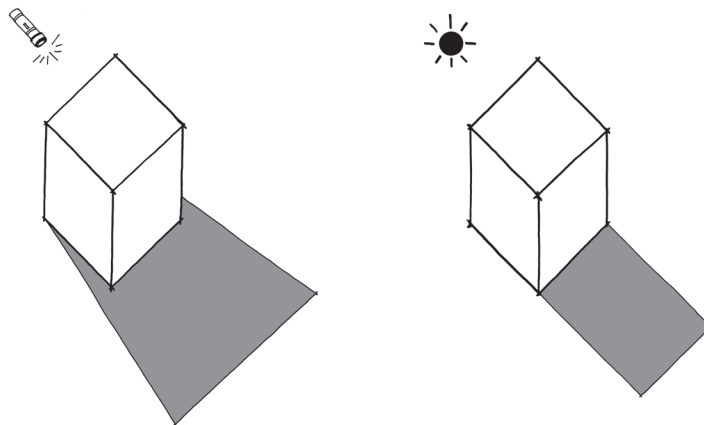
12.F.1a Identify and describe characteristics of the sun, Earth and moon as familiar objects of the solar system.

12.F.1b Identify daily, seasonal and annual patterns related to the Earth's rotation and revolution.

13A Know and apply the accepted practices of science.

13.A.1c Explain how knowledge can be gained by careful observation.

Note on using flashlights: Because the sun is so big and so far away from the earth (93 million miles), the sun's rays are always parallel to each other. A flashlight, on the other hand, splays the light and shadows outward. Holding the flashlight several feet away from the object will help to minimize the outward spread of the shadows. A flashlight does provide a quick, easy, and flexible substitution for the sun, but keep in mind that it is not quite accurate. Therefore, if at all possible, use sunlight at various times in the day, instead of flashlights.



Extensions

- Take your class outside and sit in the shadow of a building. Read a story such as *Moonbear's Shadow* by Frank Asch or the poem book *My Shadow* written by Robert Louis Stevenson and illustrated by Glenna Lang. After you have finished, talk with your students about how it feels to stay in a shadow for so long. Did they like how it felt? What does it feel like to stand in the sunshine after being in the shadows? How would they feel if sunlight never came through the windows of the classroom or their home?
- Take a walk with your class to find shadows. What are the most interesting shadows they can find? What cast these shadows? Where is the sun? Trace around some of the shadows with sidewalk chalk. Later, come back to the area to see how the shadows have moved and changed shape.
- Bring along a camera on your walk to find shadows. Let several students take turns photographing interesting shadows. Post these photos around your classroom.
- On your shadow walk, have students look for interesting shapes in the architecture, then search for the shadows created by these buildings. Do the shadows fall on the ground or on other buildings?
- Discuss the sun in relation to the rooms in students' homes. Does the sun shine directly into the room where they sleep? If so, does it shine through their window onto their face and wake them up in the morning? Which rooms does the sun shine into in the morning, afternoon, or evening? Have them observe this at home over a weekend, record what they observed, and report back to the class.
- Make photo-grams with your students. Light-sensitive paper, objects, bright sunlight, and water will create permanent 'shadows' on the paper. (You can obtain light-sensitive paper, such as that made by the SolarGraphics company, at teacher supply stores.)



The shadow of a tree. (CAAF 2002)



The shadow of the Elevated train tracks. (CAAF 2002)

Handout B

The shadow of a railing. (CAF PHOTO BY JEAN LINSNER, 2002)



The shadow of the cow sculpture outside of the Chicago Cultural Center. (CAF PHOTO BY JEAN LINSNER, 2002)

