FACILITATOR GUIDE

Bear's Shadow

Learning objectives

This activity explores these ideas:

- A shadow is created when an object blocks light from falling on a surface.
- An object's shadow always appears on the opposite side from the light source.
- Shadows change when the relative positions of the light source and the object change.

The activity can also be connected to the 2024 solar eclipse event, with the following additional learning objective:

- A *solar eclipse* occurs when the Moon passes directly between the Sun and the Earth, blocking the Sun's light and casting a shadow on Earth.

Materials

- Flashlight "sun"
- Toy bear
- Toy tree
- Landscape mat with pond and fish
- Challenge cards
- Bear's Shadow information sheet
- Moon's Shadow information sheet
- Activity and facilitator guides
- Optional: *Moonbear's Shadow* storybook by Frank Asch

The Explore Science toolkit comes complete with all necessary materials for this activity. Materials are also readily available to create or restock activity kits. Graphic files (including the landscape mat) can be downloaded from www.nisenet.org. The toy bear is available through www.learningresources.com. The sun and tree toys in this activity can be bulk ordered through qualitylogoproduct.com. The squishy sun toy has been modified to fit onto a small LED flashlight (available at discount stores). *Moonbear's Shadow* by Frank Asch can be ordered from online booksellers, or found in bookstores or your local library.

Safety

Remind participants not to shine the flashlight in anyone's eyes. Do not allow a child to place the toys in his or her mouth, and clean the toys promptly and appropriately if they come into contact with a

child's mouth. Replace the soft toys if they begin to fall apart, so that broken pieces do not present a choking hazard.

Notes to the presenter

The concepts in this activity are appropriate for all ages. This activity is designed to appeal to preschool-aged visitors, as well as accompanying adults and older children.

When doing this activity, encourage participants to switch the flashlight on and off, and use it to make a shadow of the toy bear. Then, have them experiment moving the light, the toy bear, and the tree to recreate scenes on the challenge cards:

- Move the Sun across the sky, from sunrise to sunset. What happens to Bear's shadow as the Sun moves?
- Shine the light straight down on Bear from above his head. Where is his shadow?
- Try to make Bear's shadow appear in front of him and behind him.
- Try to make Bear's shadow longer and shorter.
- Bear wants to hide in the shade of the tree. Can you help him?
- Try to make Bear's shadow touch the fish in the pond. (In the story, Bear's shadow scares the big fish away.)

This activity allows children to **model** the way the Sun casts shadows outside. Use the question prompts on the challenge cards to help children investigate how changing the flashlight's position changes the size, length, and position of shadows. As children test different positions of the flashlight, ask them to **compare their observations.** Encourage them to use their observations to **make claims** about how to make the shadows longer or shorter (or in front of or behind) the toy bear. Children can make claims either verbally or by demonstrating with their model.

The context and illustrations for the activity come from the book *Moonbear's Shadow* by Frank Asch. You can make the book available for groups to browse before or after they try the activity.

Optional extensions

If you can take children outside on a sunny day or easily darken the room you're in, you can make a connection between Bear's shadow and the children's own shadows. Reinforce the learning goals in this activity by explaining that the Sun, light bulbs, and flashlights are all examples of sources of light. When an object blocks the path of light, that object can cast a shadow. We can see the shadow on surfaces such as floors or walls.

You might also experiment with offering this activity as part of a structured story-time program. You could read *Moonbear's Shadow* by Frank Asch and then offer several extra sets of materials to allow multiple groups of children to experiment with the activity.

Optional connection to the 2024 Solar Eclipse

The next total solar eclipse to be visible in North America happens on April 8th, 2024. In the United States, the path of totality—where the entire sun will be blocked—will stretch from Texas to Maine.

You can connect the learning in Bear's Shadow activity to the solar eclipse event, using the Moon's Shadow information sheet. The concepts in this optional connection are most appropriate for slightly older children and adults.

During a solar eclipse, Earth's moon orbits between the sun and Earth and blocks the sun's light. When the moon is lined up just right between the sun and Earth it casts a shadow, and when that shadow falls onto Earth we see a solar eclipse. During a solar eclipse, Earth's Moon orbits between the Sun and Earth and blocks the Sun's light. When the Moon is lined up just right between the Sun and Earth it casts a shadow, and when that shadow falls on Earth we see a solar eclipse.

Difficult concepts

In the book *Moonbear's Shadow,* Bear's shadow disappears at noon. The assumption in the story is that the Sun is directly overhead, and thus Bear's shadow is directly underneath him. This phenomenon can occur, but only in certain places at certain times. At the equator, the Sun will be directly overhead at noon on the equinoxes (around March 20 and September 22 each year). At other locations, such as within the tropics, when this phenomenon occurs varies depending on the latitude. In the continental United States, which is not within the tropics, solar noon is when our shadows are at their shortest, but they will never completely disappear.

Light and shadows can be tricky concepts. Listen to responses or watch for interactions with guests that might indicate they are having a difficult time understanding. Remember:

- Light travels in straight lines from the source to the object (technically light travels in waves, but participants may assume straight lines when it comes to making shadows).
- Shadows are 3D and occur from the back of the object (the non-lit side) through space to another surface.
- Phases of the Moon are also shadow related, but different from an eclipse where a third object (Earth or the Moon) blocks the light from the Sun.
- We see the Moon because it reflects light from the Sun, not because it makes its own light.
- It is always dangerous to look directly at the Sun.

Staff training resources

Refer to the *Tips for Leading Hands-on Activities* sheet in your activity materials.

- An activity training video is available at vimeo.com/191168902.
- A content training video is available at vimeo.com/191171377.

The NISE Network has a curated list of programs, media, and professional development resources in the NASA Wavelength Digital Library that directly relate to the toolkit. These resources can be viewed and downloaded from nasawavelength.org/users/nisenet.

Credits and rights

This activity is adapted from Bear's Shadow, developed by The Astronomical Society of the Pacific. Retrieved from: https://www.astrosociety.org/wp-content/uploads/2015/05/BearsShadow.pdf

Bear's Shadow illustrations are courtesy Frank Asch, from the book *Moonbear's Shadow*. They have been reproduced with permission from the artist. The artist retains all copyright to these images. http://frankasch.com/

Box shadow, shadow puppet, eclipse geometry, glasses, and path of totality illustrations by Emily Maletz for the NISE Network.

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