physical science

Light and Shadow

Tricks of the Light

These animals use light and shadow to stay alive.

Black Heron

This bird wades in water, looking for tasty fish. There's just one problem. The water's surface acts like a mirror. Sunlight reflects off the surface and into the bird's eyes. The bird can't see past the reflections to the fish below.

But this bird has a trick. It spreads its wings into an umbrella shape. That blocks the light. It makes a dark shadow on the water's surface. The shadow helps it look into the water. When a fish swims into its shadow, the heron can see it and . . . **GULP!**

Atolla Jellyfish

This jellyfish lives deep in the ocean—so deep that no sunlight reaches it. Creatures there live mostly in the dark. But when they need it, many can make their own light.

This atolla jellyfish uses light for protection. If a predator tries to eat it, the jellyfish flashes a ring of blue lights. The lights act like a burglar alarm. Instead of a police officer, the lights attract a large squid. The squid rushes to the rescue and eats the predator. The jellyfish is saved!

task card 1

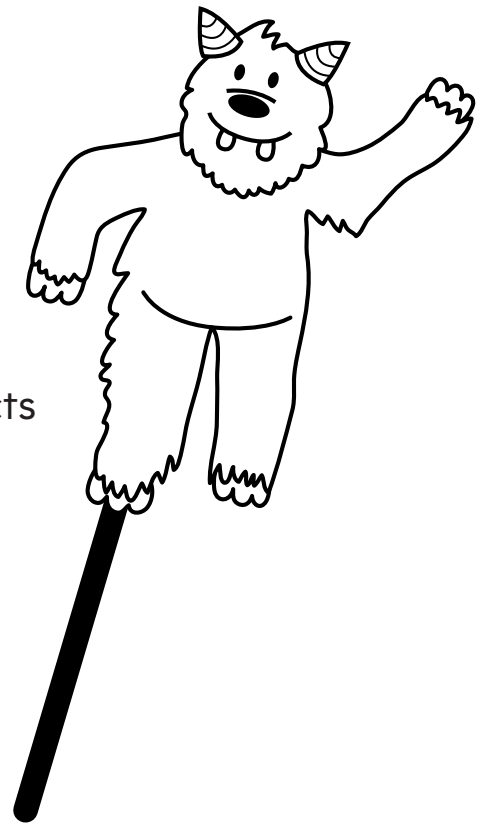
Shadow Show

Play with light and shadows to make a fun puppet show!

Materials

- ★ cardboard
- ★ pencil
- ★ scissors
- ★ flashlight
- ★ "Shadow Show" data sheet

1. Make a shadow puppet: Draw a person, monster, or animal on the cardboard. Draw a handle from the bottom of the puppet to the bottom of the cardboard. Cut out your puppet.
2. Turn off the lights in the room. Turn on the flashlight. Hold the puppet between the flashlight and a blank wall. Does it make a shadow on the wall?
3. Experiment with your puppet and your flashlight. By moving them around, how can you do each of these "special effects"?
   - Make the puppet's shadow grow bigger.
   - Make the puppet's shadow shrink.
   - Make the puppet's shadow a thin sliver.
   - Make the puppet's shadow move without moving the puppet.
4. Use your shadow puppet and special effects to perform a short show.



Name: _____

Shadow Show

Experiment with your puppet and your flashlight by moving them around. Record your observations below.

How did you make the puppet's shadow grow bigger?	**How did you make the puppet's shadow shrink?**
How did you make the puppet's shadow a thin sliver?	**How did you make the puppet's shadow move without moving the puppet?**

task card 2

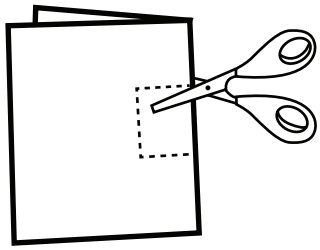
Light Blocker Test

What material blocks light the best?
What lets light through? Try this!

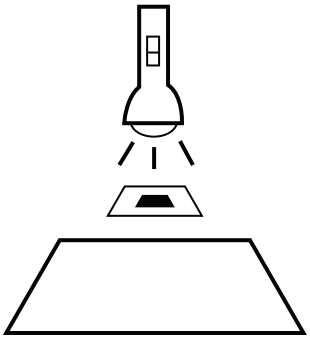
Materials

- ★ 3 index cards
- ★ scissors
- ★ flashlight
- ★ blank paper
- ★ waxed paper
- ★ tape
- ★ aluminum foil
- ★ plastic wrap
- ★ "Light Blocker Test" data sheet

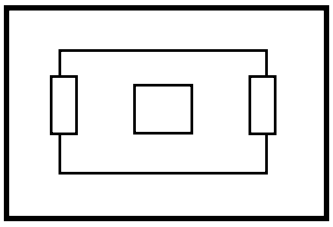
1. Fold an index card in half and cut out a simple shape. Unfold. Do the same with the two other index cards.



2. Hold one card over a blank piece of paper. Shine a flashlight through the hole in the card. What do you see on the paper? How much light comes through the hole?



3. Cut a piece of waxed paper a little bigger than the hole. Tape it over the hole in one card.



4. Repeat Step 3 with aluminum foil and plastic wrap.

5. Look at your cards. How much light do you think could go through each material? Write your predictions on your data sheet.

6. Repeat Step 2 with each of your materials. Record your observations on your data sheet.

7. Imagine your materials were thicker. Which would make the best window? Which would make the best curtain? Which would make the best wall?

Name: _____

Light Blocker Test

1. Do Steps 1 and 2 of the Task Card. What do you see on the paper? How much light comes through the hole?

Check one: ☐ a lot ☐ some ☐ none

2. Do Steps 3–6 of the Task Card. Record your predictions and observations in the chart below.

Material	I predict the material will let through this much light	I observed the material let through this much light
Waxed paper	☐ a lot ☐ some ☐ none	☐ a lot ☐ some ☐ none
Aluminum foil	☐ a lot ☐ some ☐ none	☐ a lot ☐ some ☐ none
Plastic	☐ a lot ☐ some ☐ none	☐ a lot ☐ some ☐ none

3. Imagine your materials were thicker. Which would make the best window? The best curtain? The best wall?

_____

_____

Next Generation Science Standards
PS4.B Electromagnetic Radiation
PS1.A Structure and Properties of Matter
ETS1.B Developing Possible Solutions

Background

The black heron is a wading bird indigenous to West Africa. Besides helping it see better by cutting down on reflection, some scientists believe the heron's shadow may actually attract fish. The dark area created by the shadow may draw fish by giving them a false sense of safety.

Dr. Edith Widder, a biologist and deep-sea explorer who is a leading researcher in the field of *bioluminescence*, has found deep-sea creatures that use lights to lure food, scare predators, attract mates, and—as with the atolla jellyfish—lure larger predators to get themselves out of danger. But she says there is still much to learn about what bioluminescent creatures are doing—and saying—with their flashing lights.

Hands-On Hints

Task Card 1: Shadow Show

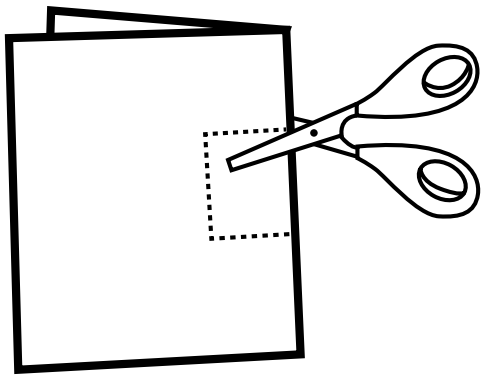
Make sure children have access to scissors that will cut the cardboard. Card stock, which is thinner and easier to cut than regular cardboard, will also work. To make a card-stock puppet less floppy, replace the handle with a taped-on straw or popsicle stick.

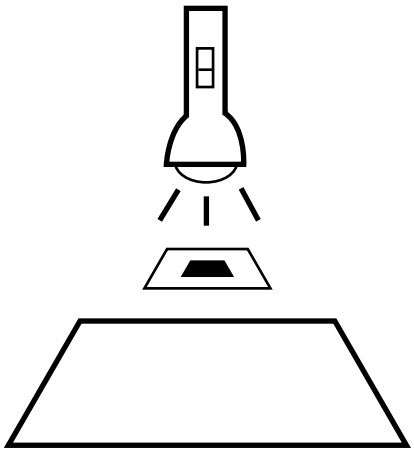
Children can make the puppet's shadow bigger by moving the puppet closer to the flashlight—or the flashlight closer to the puppet. They can make the shadow smaller again by putting more distance between the puppet and the light. Children can make the puppet's shadow a thin sliver by giving the puppet a quarter turn, so the light hits the edge of the cardboard. They can make the puppet's shadow move by moving the flashlight, even if the puppet stays still. The farther from the wall the puppet is at the time, the more it will move.

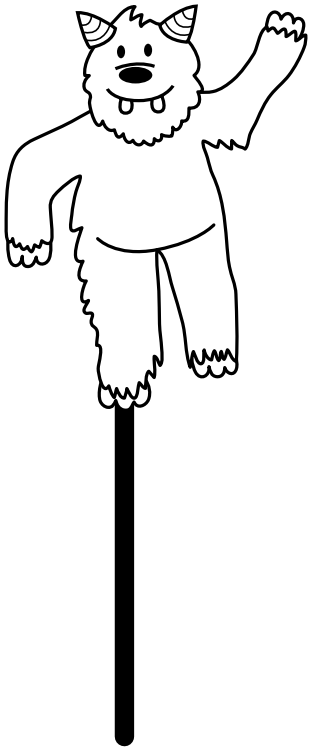
Task Card 2: Light Blocker Test

You may wish to share this vocabulary with older children: If light can pass easily through a material (like plastic wrap), we say it is *transparent*. If light cannot pass through a material (like aluminum foil), we say it is *opaque*. If a material lets only some light through (like waxed paper), we call it *translucent*.

As an extension to the activity, you might want to provide children with an assortment of other materials to test, such as plastic shopping bags, cloth scraps, tissue paper, colored cellophane, and clean food wrappers.







Photos ©: cover, girl jumping: Annie Otzen Photography/Getty Images; shadow puppets: Anima Fotografie aka Des Cannon/Getty Images; heron: Matthias Graben/Getty Images; scarf: igorr1/iStockphoto; red jellyfish: Bill Curtsinger/National Geographic Creative; blue jellyfish: Dr. Edith Widder/ORCA.

For optimal results, we suggest following these steps:

1. Introduce the topic by reading aloud the nonfiction acticle. The article helps build background knowledge and provides context for the hands-on activities. You can project it onto your interactive white-board as you read it aloud. There is also a printable version that you can distribute to students so they can read along.

2. Divide the class into small groups. Hand each group a Task Card, and give each student a Data Sheet. (We recommend starting with Task Card 1.) Together with the class, read aloud the steps of the activity to ensure everyone understands what to do. You may also want to have each group conduct an inventory of their materials to make sure they have everything they need.

3. Have students do the activity and record on their Data Sheets.

4. Make sure to leave enough time before the end of the period so you can have a class discussion about the activity. Invite groups to share their findings and results, including any challenges they may have faced.

5. Gather students' data sheets to assess for understanding.

If you plan to continue the unit in your next lesson with the second Task Card, you might want to review the article with the class. In some cases, Task Card 2 builds upon Task Card 1, so you may want to quickly go over the first activity as well.

At the end of a unit, consider asking students to evaluate the topic and activities. This can be as simple as a thumbs-up or thumbs-down. Engage them in a discussion about what they liked or did not like and why. You might find this feedback useful for future lessons.

The two Task Cards feature hands-on activities that incorporate the following eight science and engineering practices—identified by the NGSS as essential for all students to learn:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

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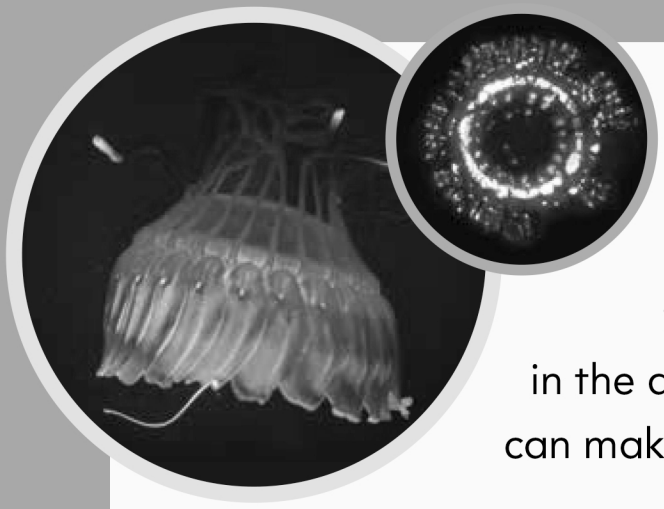

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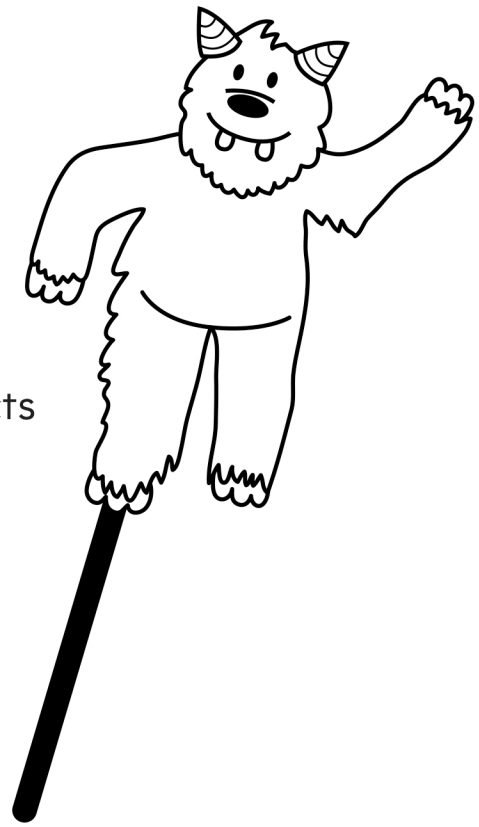

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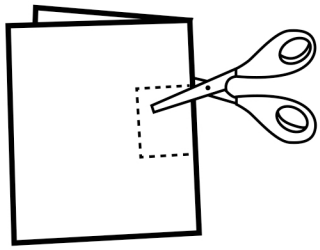

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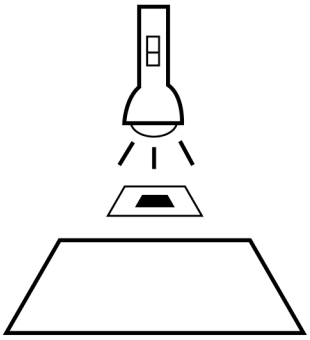

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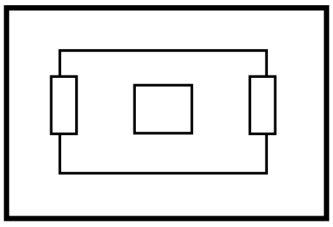

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