

GIVE SPARK · HANDS-ON SCIENCE LAB

Shadow Giants

How can we make the same object cast a bigger shadow?

Teacher Guide

Grades 3–5 · Light and shadows · 55 minutes

FREE LAB

OVERVIEW

The lab at a glance

One lesson, one driving question and a shadow children learn to control.

THE DRIVING QUESTION

How can we make the same object cast a bigger shadow?

Children explore first, then measure carefully enough to show someone else what happens.

What children do

Teams set up a flashlight, a small card shape and a screen in a straight line. They explore freely for a few minutes, then measure the height of the shadow with the shape at three marked distances from the flashlight. They use the pattern in their measurements to make a shadow about twice the height of the shape.

What children learn

A small object can cast a much larger shadow without changing its own size. Light spreads outward from the flashlight, and an opaque object blocks some of it. With the flashlight and the screen fixed, the position of the object decides how much of the spreading light it blocks, and so how big the shadow is.

Success looks like

1. I kept the flashlight, the screen and the object the same and changed only the distance.
2. I measured the shadow at each mark and checked one position twice.
3. I used my measurements to choose where to put the object for the challenge.

Illustrative measurements

OBJECT'S DISTANCE FROM THE FLASHLIGHT	SHADOW OF A 5 CM SHAPE
15 cm	About 20 cm tall, with softer edges
30 cm	About 10 cm tall
45 cm	About 7 cm tall, with sharper edges

These are illustrative values for a small light source, with the flashlight and screen 60 cm apart. Use the children's measurements. Do not correct their results to match this table.

AT A GLANCE

Time: 55 minutes.

Grouping: teams of three.

Standards link: builds on NGSS 1-PS4-3, the effect of placing objects in the path of a beam of light, and adds measurement and fair testing for grades 3–5.

SESSION PLAN

STAGE	MIN
Introduce the phenomenon	5
Explore	8
Set up a fair comparison	7
Measure	15
Apply the pattern	10
Close	10
Total	**55**

THE STUDENT RESOURCE

A separate one-page PDF with the results table, the challenge, a space for a side-view diagram and the closing sentences.

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PREPARATION

Get ready

What to gather, how to lay out a station and how dark the room needs to be.

Materials

For each team

- A flashlight with a single compact light source
- A small opaque card shape, about 5 cm tall
- Modeling clay or a small stand to hold the shape upright
- A white wall, or an upright sheet of white card as a screen, at least 25 cm tall
- A ruler or tape measure
- Masking tape
- The student page and a pencil

A simple square, an animal silhouette or a person shape works well. Each team uses the same shape throughout.

Set up each station

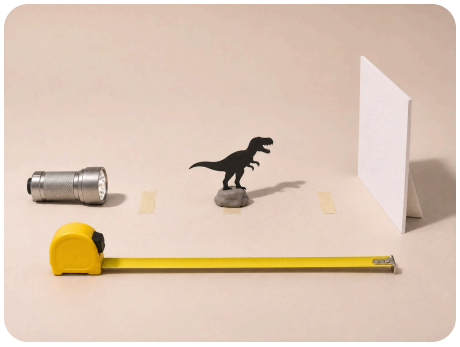
1. Place the flashlight on the table, pointing at the screen. Tape it down so it cannot roll.
2. Set the screen 60 cm from the front of the flashlight.
3. Put a strip of masking tape on the table at 15 cm, 30 cm and 45 cm from the flashlight. Write the distance on each strip.
4. Stand the shape in its clay at the 30 cm mark and check that the flashlight, the shape and the screen are in one straight line.

The room

Dim the room enough to see the shadows clearly. Complete darkness is not needed, and children still have to read a ruler. Spread the stations out so one team's light does not fall on another team's screen.

The shape

Cut the shapes from dark card before the lesson, or have each team cut its own in the first few minutes. Measure the height of the shape itself. Children need that number for the challenge.



One station. Flashlight, three tape marks, the shape in its clay and the screen, all in one line.

SAFETY

Nobody shines a flashlight into anyone's eyes. In a dim room, keep bags and chairs out of the walkways.

WHICH FLASHLIGHT

A flashlight with one small bulb or a single LED gives the sharpest shadow. A phone flashlight works well. A wide lantern or a flashlight with many LEDs gives blurred, doubled edges.

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TEACHING SEQUENCE

Run the lesson

A giant shadow raises the question. Three marked positions and a ruler give the evidence.

Introduce the phenomenon 5 MINUTES

DO Show the small shape in your hand. Then use a flashlight to cast a large shadow of it on the wall.

ASK "The object stayed the same size. How did its shadow become so large?"

Invite predictions. Do not explain yet.

Explore 8 MINUTES

DO Teams move the shape between the flashlight and the screen and notice what happens. Then bring them back to the question.

ASK "How can we compare positions carefully enough to show someone else what happens?"

Set up a fair comparison 7 MINUTES

DO Agree what stays fixed: the flashlight, the screen, the shape, and the shape standing upright and facing the same way. Only the distance of the shape from the flashlight changes.

Measure 15 MINUTES

1. Place the shape at the 15 cm mark.
2. Measure the height of the shadow on the screen.
3. Record the height and note whether the edges are sharp or fuzzy.
4. Repeat at 30 cm and at 45 cm.
5. Go back to one position and measure again to check the result.

If the shadow is taller than the screen, children record "Larger than the screen". They do not guess at an edge they cannot see.

Apply the pattern 10 MINUTES

SAY *"Make a shadow about twice the height of your shape."*

DO Teams choose a position, check the shadow with the ruler and adjust. They mark the spot with tape and record its distance.

ASK "How did your earlier measurements help you choose where to start?"

Close 10 MINUTES

DO Children draw a side-view diagram showing the flashlight, the shape and the screen. They complete the sentences. "When we moved the object closer to ___, its shadow became ___. We kept ___ the same." Allow a few minutes for cleanup within this stage.

LOOK FOR

Children who use the measurements to make a decision. "At 30 it was 10, and we need 10, so we start there" shows they have seen the pattern.

IF THIS HAPPENS

The shadow has two edges or looks blurred. The flashlight has more than one light source or a wide lens. Swap it, or measure to the darkest part of the shadow.

The shadow leans or stretches. The three parts are not in line, or the shape is tilted. Stand it upright and line it up again.

The second measurement at one position is different. Ask what might have moved. This is the reason for checking.

EXPLORE BEFORE MEASURING

Eight minutes of free movement gives children the idea. The marks and the ruler then turn the idea into evidence.

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The science behind it

How light makes a shadow, why distance changes its size and how to adjust the investigation.

The science behind it

Light travels in straight lines and spreads outward from the flashlight. An opaque object blocks the light that hits it, and the dark area behind it on the screen is the shadow.

Picture the light as a cone that widens as it leaves the flashlight. Close to the flashlight the cone is narrow, so a small shape blocks a large share of it, and that blocked share goes on widening all the way to the screen. Farther from the flashlight the same shape blocks a smaller share of a wider cone, and the shadow is smaller.

With a small light source the pattern is regular. When the shape is halfway between the flashlight and the screen, the shadow is about twice as tall as the shape. When the shape is a quarter of the way along, the shadow is about four times as tall.

The edges change too. A shape close to the flashlight casts a larger shadow with softer edges, and a shape close to the screen casts a smaller shadow with sharper edges.

Ideas children often bring

A CHILD MIGHT SAY	YOU COULD RESPOND
“The shadow is bigger because the light is brighter there.”	Ask them to trace with a ruler from the flashlight past the top of the shape to the screen.
“Moving the object closer to the screen makes it bigger.”	Let the measurements decide. Which mark gave the tallest shadow?
“The shadow is part of the object.”	The shadow is where the light did not reach. Take the light away and ask where it went.

Support and challenge

Support. Use a plain square shape, which has a clear top and bottom edge to measure between.

Challenge. For grade 5, ask teams to choose a target shadow height between two of the heights they measured. They predict a new position for the shape, then test it.

ASSESSMENT

Use the student page and the challenge.

Fair test: names what stayed fixed.

Measuring: records three heights and one repeated check.

Using the pattern: chooses a sensible starting position for the challenge and explains why.

TAKE IT FURTHER

Move the screen. Keep the shape still and move the screen back. What happens to the shadow?

Shadow theater. Teams make two characters and use distance to make one a giant.

Outside. Measure a child’s shadow in the morning and at noon and compare.

FINAL EXPLANATION

Ask every team for the same three things. Tell us what you found, show the evidence, and explain what you think caused it.

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Vicky Brooks
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Shadow giants

How can we make the same object cast a bigger shadow?

Name _____ **Date** _____

1 Our fair test

Our shape is _____ cm tall. What will we keep the same?

2 Our results

Measure the height of the shadow on the screen at each mark.

DISTANCE FROM THE FLASHLIGHT	SHADOW HEIGHT	WHAT DID ITS EDGES LOOK LIKE?
15 cm	cm	
30 cm	cm	
45 cm	cm	
Check again: _____ cm	cm	

3 The challenge

Make a shadow about twice the height of your shape.

We put the shape _____ cm from the flashlight. The shadow was _____ cm tall.

Our earlier measurements helped because _____

4 Draw it from the side

Show the flashlight, the shape, the screen and the shadow. Draw the light as straight lines.

5 What we found

When we moved the object closer to _____, its shadow became _____.

We kept _____ the same.

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