# Science in the early years: Light and shadows

## Activity description

This activity is best suited to children in Foundation to Year 2 (F–2) as it addresses the Year 1 Science Understandings outcome as well as addressing Science Inquiry Skills outcomes for F–2. It is also suitable for preschoolers to help overcome common misconceptions about shadow formation. F–2 students should be encouraged to explain why shadows are formed as well as describe them. Preschoolers should be given the opportunity to describe and explain shadows too.

In small groups, children create and explore the requirements for making shadows. Using toys that will block out the light and a torch, they make *predictions* about when a shadow will form, what shape it will have, and how large it will be. They then *check* their ideas by placing a torch and an object in different positions. Children *record* what they *observe* and *communicate* (describe and explain) what they found out. They are given the opportunity to explain that objects must block light from the torch for a shadow to form.

**Links to the EYLF**

**Outcome 4**
Children are confident and involved learners.

**Key components**
Children develop dispositions for learning curiosity, cooperation, confidence, creativity, commitment, enthusiasm, persistence, imagination and reflexivity.

Children develop a range of skills and processes such as problem-solving, enquiry, experimentation, hypothesising, researching and investigating.

# Link to the Australian Curriculum (Foundation to Year 2)

| | Foundation | Year 1 | Year 2 |
|---|---|---|---|
| **Science Understanding** | | **Physical sciences**<br>Light and sound are produced by a range of sources and can be sensed (ACSSU020) | |
| **Science Inquiry Skills** | **Questioning and predicting**<br>Pose and respond to questions about familiar objects and events (ACSIS014) | **Questioning and predicting**<br>Pose and respond to questions, and make predictions about familiar objects and events (ACSIS024) | **Questioning and predicting**<br>Pose and respond to questions, and make predictions about familiar objects and events (ACSIS037) |
| | **Planning and conducting**<br>Participate in guided investigations and make observations using the senses (ACSIS011) | **Planning and conducting**<br>Participate in guided investigations to explore and answer questions (ACSIS025)<br>Use informal measurements to collect and record observations, using digital technologies as appropriate (ACSIS026) | **Planning and conducting**<br>Participate in guided investigations to explore and answer questions (ACSIS038)<br>Use informal measurements to collect and record observations, using digital technologies as appropriate (ACSIS039) |
| | **Processing and analysing data and information**<br>Engage in discussions about observations and represent ideas (ACSIS233) | **Processing and analysing data and information**<br>Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS027) | **Processing and analysing data and information**<br>Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS040) |
| | | **Evaluating**<br>Compare observations with those of others (ACSIS213) | **Evaluating**<br>Compare observations with those of others (ACSIS041) |
| | **Communicating**<br>Share observations and ideas (ACSIS012) | **Communicating**<br>Represent and communicate observations and ideas in a variety of ways (ACSIS029) | **Communicating**<br>Represent and communicate observations and ideas in a variety of ways (ACSIS042) |

*Source:* https://www.australiancurriculum.edu.au/f-10-curriculum/learning-f-2/

## Notes about shadow formation

Whether or not a shadow is created depends on the extent to which an object blocks light falling upon it.

Objects can be made of opaque, translucent or transparent materials:

- Opaque: prevents light from travelling through the material.
- Translucent: allows some light to pass through the material.
- Transparent: allows light to pass through, so objects can be seen through the material.

Shadows will form when an object made of opaque material blocks light.

Opaque materials block all of the light from a light source such as a torch. The shadows cast by opaque objects tend to be dark. When an object is made of a translucent material, some light passes through the material, and a fainter shadow is formed. Transparent materials do not block any of the light falling on them, so a shadow is not formed (e.g. clear glass, a sheet of clear plastic wrap).

Shadows are formed because light travels in straight lines. The object must be located between the light source and the surface on which the shadow is cast.

When an object is directly in front of a light source, the shadow cast will have the same (outline) shape as the object.

Moving the object closer to the light source will result in the shadow cast being enlarged (much bigger than the object itself); moving the object further away from the light source will result in the shadow cast being reduced in size. An object closer to the light source will block a relatively larger area of the light coming from the light source; and an object further from a light source will block a relatively small area of the light coming from the light source.

When light from a light source hits an object at an angle, the length of the shadow changes. We notice this effect during the day. In the early morning and late afternoon, the angle between the incoming sunlight and the ground (angle of incidence) is relatively small (the sun is low down in the sky and closer to horizontal), and shadows formed are long. In the middle of the day, the angle of incidence is large, and the shadow cast is short as the sun is nearer to directly overhead (angle of incidence will be near to 90 degrees: closer to vertical).

To find out more about misconceptions that young learners might hold about shadow formation and many other topics, refer to Pine, Messer and St. John (2001).

## What to provide?

- An area inside that can be darkened, with a clear wall space to use as a projection space (to cast the shadows onto).
- A variety of solid toys (e.g. a sheep, a dinosaur, a spade, a ball).
- A small torch (globe light rather than an LED as this will throw a better light source).

### Learning intention

- To be able to record and communicate results of an experiment (EYLF, F–2)
- To understand how shadows are formed (EYLF, F–2)

### Success criteria

- I can use drawings to record my results and discuss what happened in an experiment (EYLF, F–2)
- I can explain that shadows are formed when objects block light (EYLF, F–2)

## What to do?

**Before providing the torches and toys, assemble the group of children. Gauge the children's current understanding about the concept of shadow formation.**

**Have you ever noticed your shadow on the ground when you've been playing outside? What needs to happen to make a shadow?**
(SU: Physical science; SIS: Questioning and predicting)

Listen to gauge children's understanding of the need for a source of light (the sun in this example) and an object to block the light (their body in this example).

*Responses to look for that indicate children are aware that a light source is needed:* 'It needs to be a sunny day', 'I need to be standing in the sun', 'I need to get in the way of the sun to make a shadow'; or they are aware that the shadow needs to be cast (e.g. You need somewhere to see the shadow on the ground; 'I can see it on the basketball court in the morning on my way to school').

Affirm these correct observations.

Children might hold misconceptions about shadow formation such as: a shadow forms between the sun and themselves; shadows form when the sun is shining, without an object (such as a person) being involved. In these cases, in the next part of the activity, direct them to think about where the toy needs to be placed when they are making shadows. Will a shadow be formed only when a torch is shining on the wall?

**Organise children to work in pairs or small groups so they can share their observations and cooperate to create shadows.**

**Show me how you can make shadows on the wall using a torch and the animals.**
(SIS: Planning and conducting)

Children experiment using the torch and toys to cast a shadow on the wall. They observe what happens.

Affirm all correct alignments of the torch and toys. Point out the shadows on the wall.

If children are having trouble placing the torch and object in the correct alignment, suggest they try something different.

**What can you do to make the toy shadows larger or smaller? Can you make a prediction?**
(SIS: Questioning and predicting)

Affirm all correct predictions (moving the object closer or further away from the torch will change the size of its shadow).

*Responses to look for:* Children should be able to predict that changing the position of the light source and object will change the size of the shadow. Before experimenting, some children might be able to make the connection that when objects are closer to the light source, relatively more light is blocked, so the shadow looks larger, and vice versa.

Children experiment with changing the size of the shadows created.

They should check whether their observations matched their predictions.

**How did you make the toy shadows larger?**
(SIS: Processing and analysing data and information, Communicating)

*Responses to look for:* Children can communicate their findings by showing how to make the toy's shadow larger. Prompt them to talk about whether their prediction was correct; prompt them to compare what happens when the toy is moved further away from the torch.

## What to record?

(SIS: Evaluating, Communicating)

Children record their findings by drawing a picture of where they placed the torch and toy and show the shadow created on the screen. A large piece of drawing paper could be affixed to the wall, and children could trace around two shadows created by their team mate: one large and one small.

## What comes next?

Extend the learning by having children explore what happens to the shape of a shadow when light hits it at an angle. They can explore the length of shadows cast at different times of the day, then create shadows like these on the ground, using a torch and toys.

# References

Pine, K., Messer, D., & St. John, K. (2001). Children's misconceptions in primary science: A survey of teachers' views. *Research in Science & Technological Education, 19*:1, 79–96. https://doi.org/10.1080/02635140120046240