**ACTIVITY: Investigating shadows and the position of the Sun**

**Activity idea**

In this activity, students use scientific models and exploration to observe the position of the Sun and its physical effect on light and shadows.

By the end of this activity, students should be able to:

* recognise that the size and shape of shadows change during the day
* recognise the changing position of the Sun causes shadows to change
* correlate longer shadows with the Sun’s position lower on the horizon
* correlate shorter shadows with the Sun’s position higher in the sky.

# For teachers

## Introduction/background

Light is a complex topic. The rotation of the Earth on its axis is also a complex topic. However, through scientific modelling and observation, young students can begin to build an understanding of fundamental science concepts regarding the spinning Earth, the position of the Sun and its effect on light and shadows. This activity is an initial investigation of concepts that – for most students – require many years to fully develop.

***Key science concepts***

The New Zealand Ministry of Education resource [Building Science Concepts Book 9: *Shadows: Effects of the Absence of Light*](https://scienceonline.tki.org.nz/What-do-my-students-need-to-learn/Building-Science-Concepts/Titles-and-concept-overviews/Shadows-Effects-of-the-Absence-of-Light)lists key concepts and how they might build in sequence for the overarching concept: Changes in the shape and size of shadows are caused by changes in the relative positions of the Sun and Earth:

* We see definite shadows on a sunny day.
* The sizes and shapes of shadows change throughout the day.
* The size and shapes of shadows are related to the position of the Sun in the sky.
* As the Earth spins, the angle at which the Sun’s rays strike the Earth changes.

***The Earth, the Sun and shadows***

Shadows change throughout the day. The Sun’s position in the sky affects the length of shadows. When the Sun is low on the horizon, shadows are long. When the Sun is high in the sky, the shadows are much shorter. The reason for the changing position of the Sun is the spinning of the Earth on its axis. Although the Sun appears to move through the sky, it is actually our view of the Sun that changes, as explained in the article [Light and shadows](https://www.sciencelearn.org.nz/resources/2771-light-and-shadows).

***Developing student understanding***

The activity [Investigating shadows](https://www.sciencelearn.org.nz/resources/2772-investigating-shadows) has ideas for teaching basic concepts about light and shadows. Educators are encouraged to explore some of these experiences first to give students a foundation on which to build their conceptual knowledge.

***Engaging discussion and deepening understanding***

While students are exploring light and shadows, use the opportunities to ask questions and engage in discussion to:

* check prior knowledge about the Sun, light and shadows
* check for (and challenge) [alternative conceptions](https://www.sciencelearn.org.nz/resources/63-alternative-conceptions-about-light)
* develop content vocabulary
* develop, consolidate or extend thinking
* encourage communication, comparison and analysis between individuals and groups
* look for opportunities for students to design simple investigations to answer questions.

## What you need

* Globe – with your location marked by a cone or lump of Blu-Tack
* Torch – labelled or decorated to represent the Sun
* Concrete surface or similar that is exposed to full sunlight
* Chalk
* Device to take photographs

## What to do

**Inside the classroom**

1. Use the image of a [sunrise](https://www.sciencelearn.org.nz/images/3548-sunrise-viewed-from-joides-resolution) to elicit students’ prior knowledge about:
* day and night
* the Sun’s position in the sky and how it changes during the day (and night).
1. Discuss how scientists often use models to represent things that are too big or too tricky to use in real life – in this case, the Sun and the Earth. Discuss how the torch and the globe are similar to the Sun and the Earth.
2. Slowly spin the globe and discuss how:
* the Earth spins every 24 hours
* this creates our day and night
* this happens again and again and never stops.
1. Shine the ‘Sun’ on New Zealand to represent daytime. Turn (spin) the globe to represent night-time.
2. Discuss why it is dark at night. (New Zealand is actually in a shadow. The bulk of the Earth is between our location and the Sun.)
3. Refer to the sunrise image and challenge students to transfer this information to the spinning of the globe (Earth) and the position of the Sun.
4. Spin the globe, asking students to say stop when it appears New Zealand is about to experience the sunrise. Discuss student thinking – we often see the morning light before we see the Sun appear on the horizon.
5. Continue to slowly spin the globe to observe the relative position of the light (Sun) to parts of the Earth.
6. Discuss how this model represents what we see happening every day. (Although it appears that the Sun is moving across the sky, it is actually our view of the Sun that changes, due to the Earth’s spin. This is a difficult concept for young students to grasp as it differs from what they see.)
7. Use the image of a [shadow](https://www.sciencelearn.org.nz/images/3938-objects-and-shadows) to elicit students’ prior knowledge about the position of the Sun and its effects on shadows.

**Outside the classroom**

1. At the beginning the school day, locate the position of the Sun in the sky. **Important:** Remind children that looking at the Sun is very dangerous. They can glance at the sky, but they should not look directly at the Sun.
2. Working in pairs, have students use chalk to draw around the feet of another student, then trace around the person’s shadow.
3. Discuss/make predictions about potential changes to the shadows during the day.
4. Return twice during the day. Students stand in the outline of their feet while a partner traces around the new shadow. Note the position of the Sun in the sky. Photograph the outlines for future discussions.
5. Discuss the relationship between the Sun’s position in the sky to the size and shape of the shadows.
6. Use the Sun (torch) and Earth (globe) to compare what happens on the model with what happens outdoors. Encourage students to narrate what would be happening to the size and shape of their shadows as the Earth spins in a 24-hour cycle.
7. If time allows, repeat the experience at the same times the following day. Make observations and discuss the results.

## Extension ideas

1. Make this activity cross-curricular by measuring the length of each shadow and creating simple bar graphs.
2. Use the following resources as part of literacy activities:
* ‘Shadow sleeps’, *Connected* No. 1, 1998, pages 8–11.
* ‘Make a shadow clock’, *Connected* No. 1, 1998, page 2.
* ‘My shadow’, *Journal of Young People’s Writing* 2006.
1. The length and shape of shadows also change with the seasons due to the tilt of the Earth on its axis. Make shadow measurements throughout the school year to visualise the changes. Photograph the shadows, make measurements and graphs. View the evidence and discuss the changes.