

Summary of learning goals

- Students explore the relationship between three-dimensional (3D) objects and common two-dimensional (2D) shapes. They are asked to investigate the shape of shadows cast by different 3D objects.
- They are also asked to consider different perspectives of a single object and the ways in which the shadow shapes may vary.

Australian Curriculum: Mathematics (Year 1)

ACMMG022: Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features.

Summary of lessons

Who is this sequence for?

- This task looks at how 3D objects are composed of 2D shapes. Students must be able to name familiar 2D shapes and 3D objects and have a basic knowledge of the properties of these shapes and objects.
- Students should be familiar with the language associated with shapes, such as sides and corners. They should be familiar with the language of objects, including face, edges and corners.

Lesson 1: Shadows

Students explore the relationship between 3D objects and common 2D shapes. They investigate and predict the shape of shadows cast by different 3D objects. Students are also asked to consider different perspectives of a single object and the ways in which its shadow shapes may vary.

Reflection on this sequence

Rationale

We live in a 3D world and are constantly interacting with 3D objects. Being able to reason about and work flexibly with these objects is vitally important for everyday life and in many professions. Despite this, much of what happens in the classroom tends to focus on 2D shapes. Even when 3D objects are used in the classroom, they are often in 2D form as images presented on paper. It is critical that students are provided with opportunities to physically interact with and manipulate 3D objects.

This task presents an investigation into the composition of 3D objects. Students explore the shadows of 3D objects to see that all objects are composed of 2D shapes. Isolating and exploring these shadows reveals important properties of the objects, such as their structure and component parts. This builds students' capacity to construct, manipulate and reason more deeply about 3D objects.



reSolve mathematics is purposeful

- Students' creativity and imagination are harnessed in this task as they cast and explore shadows made by 3D objects. Through the shadows, the 3D objects are decomposed to 2D shapes, facilitating a parallel exploration into 3D and 2D geometry.
- Students use objects from their everyday life and consider how they are constructed by looking at their shadows.
- As they predict what shadows might be cast by different objects and then discover the shadow shapes, students' knowledge of and language use in geometry is developed.



reSolve tasks are inclusive and challenging

- This task provides access for all students through common experience. As our world is three-dimensional, students can draw on their lived experience for this investigation. Shadows are also very familiar to students. It is likely that students will all have played games with shadows and explored the shapes of shadows cast by different objects in different orientations.
- The task is also one with a low floor and a high ceiling. The low floor of this task can be accessed by simply exploring shadows when manipulating familiar 3D objects. The high ceiling requires students to explore the various shadows that one object can create when it is positioned in different orientations. This is highlighted by the extending prompt, which asks students to consider the minimum number of shapes required to cast all the given shadows.



reSolve classrooms have a knowledge-building culture

- These activities focus on relating known and tangible concepts (3D objects) with abstract concepts (2D shapes). The task encourages active exploration and teamwork as students work collaboratively to explore the shadows, and concludes with class discussions around the objects and their shadows.

Shadows

Y1

About this lesson

Students explore the relationship between three-dimensional (3D) objects and common two-dimensional (2D) shapes. They investigate and predict the shape of shadows cast by different 3D objects. Students are asked to think about how changing the orientation of an object alters the shadow that is made. By manipulating shapes in this way, students see that one shape may cast multiple 2D shapes as a shadow.

Australian Curriculum: Mathematics (Year 1)

ACMMG022: Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features.

Mathematical purpose

- To identify 2D shapes that are part of the composition of 3D objects.

Learning intention

- To find 2D shapes in 3D objects.



Time

A lesson of approximately 1 hour.



Vocabulary

- 3D objects and 2D shapes
- face of an object
- perspective
- Correct mathematical language is critical; ensure words such as prism, pyramid and sphere are used.



Resources

- reSolve PDF *Shadows Image* or a printout of the page (ideally A3 size or larger)
- torches for students (optional)

Creating and identifying shadow shapes

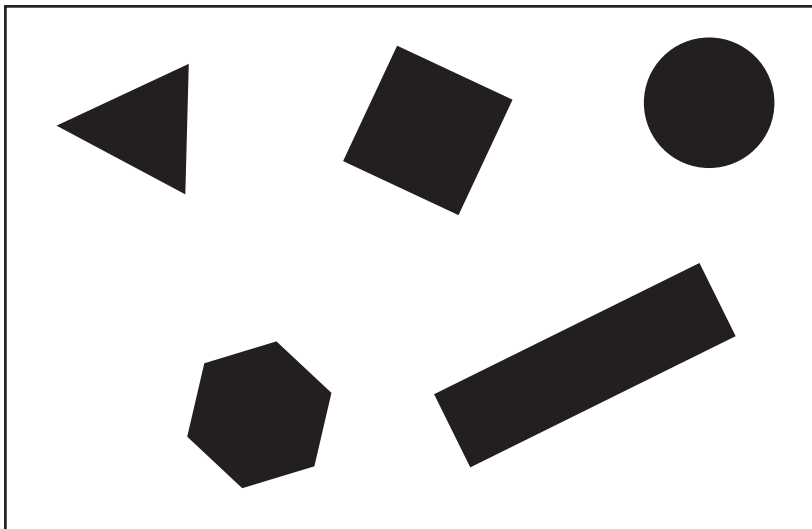
Introduction to shadows

Use a torch or other light source to create shadows on a whiteboard or wall. Look at the different shapes made by everyday 3D objects. Students can predict the shapes of the shadows. Look at the objects from different perspectives and the different shadow shapes that can be made from the one object.



Resources: Show the *Shadows Image*.

Pose the question: *What objects might have made these shadows?*



Exploration



Resources: Allow students to collect different objects and sort them according to which shadows they may have made. To assist the investigation, students could use a light source (e.g. torch, projector) to experiment with the shadows.

Ask students to explain which **perspective** of the object would create the corresponding shadow.

Pose the question: *Can you find an object that could create more than one of these shadows?*

Questioning to direct the investigation and challenge students' thinking and reasoning

- *How many different shapes can one object create?*
 - ◊ Most shapes will create two differently shaped shadows. Some students might find that it is possible to make a rectangle cast a square shadow and vice versa by carefully angling the torch or light source.
- *How could you predict the shadow that an object will make?*
 - ◊ This question focuses students' attention on noticing the shape of the **faces** of an object.



Extending prompt:

- What is the **smallest** number of objects you would need to make all of the shadows?
 - ◊ Using different angles and perspectives, all five shadows can be made with only a cube and a cone.

Reflection

Students can share their work and show the perspectives that will create different shadow shapes.

Relate the shape of the shadows back to the faces of the 3D objects. Discuss how 2D shapes can be found in 3D objects. Identifying the 2D shapes in an object helps us to name the object and describe its properties.

You could also look at how this helps us draw 3D objects; that is, represent a 3D object in 2D form.

Ask the students to explain how they might now predict the shadow shapes of an object.

Further activities

Activity 1

Provide students with different objects (e.g. building blocks) and use paint to create prints of the different faces of the object.

Pose the questions: *What different shapes do you think the faces will make?*
How many different shapes do you think your object will make?

Activity 2

Provide the students with a collection of pattern blocks. Have them collect four of the same block and create a stack to make a 3D object.

Pose the question: *What are the shapes of the different faces of the object?*