CHAPTER 5: Foundations of Geometry

Introduction

In this chapter, teachers explore what young children learn about geometry in the early grades. Teachers are encouraged to complete the mini-modules in order.
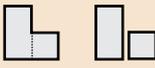
Mini-Modules in This Chapter

A) Two-dimensional (2D) shapes
B) Three-dimensional (3D) shapes
C) Spatial reasoning

Goals of the Chapter

This chapter aims to help teachers:

- Describe what students learn about 2D and 3D shapes and their position in space.
- Identify how materials are used to teach children about geometry.
- Develop new teaching practices.

Key terms

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Angle	The space between two lines that meet on a 2D shape	
Compose[1]	To put simple shapes together to create more complex shapes	
Decompose	To break a shape down into smaller parts	
Edge	A line in a 3D shape where two faces meet	
Face	A surface on a 3D shape (e.g., a square face on a cube)	
Position	The location of a shape or object (e.g., the triangle is on top of the square)	
Property	A characteristic used to define a shape (e.g., a square has four sides); also called an *attribute*	
Reasoning	The process of thinking logically about math	
Side	A line segment that forms a 2D shape	
Spatial reasoning	The ability to visualize and understand the position of, direction of, and relationship between objects in space	
Three-dimensional (3D) shape	A solid shape with three dimensions: length, width, and depth	
Two-dimensional (2D) shape	A flat or plane shape that has two dimensions (length and width) and is closed (i.e., without openings)	
Vertex	A point where sides meet on a 2D shape, or where edges meet on a 3D shape (plural: vertices); sometimes called a corner	

1 See Chapter 1 for how to compose and decompose numbers.

Using Geometry Materials

Working with geometric shapes helps children develop spatial reasoning skills and make sense of the world around them. It is important to create opportunities for children to work with 2D and 3D shapes. It is good to have cut-out 2D shapes, rather than only pictures, because they can be held, flipped, rotated, and folded.

2D shapes

3D shapes

2D SHAPES CAN BE CREATED, FOUND, AND DRAWN:

❑ **Create 2D shapes** by drawing them on paper or cardboard and cutting them out.

  ❍ Create a variety of different shapes (e.g., triangles of different shapes and sizes).
  ❍ Create a set of different shapes out of the same material so that children focus on identifying the geometric properties of the shapes instead of other features, like colors or patterns.

❑ **Find 2D shapes** in the environment. For example, students may identify that the flat face of a blackboard is a rectangle.

❑ **Draw 2D shapes** on paper or the board, and have students draw shapes.
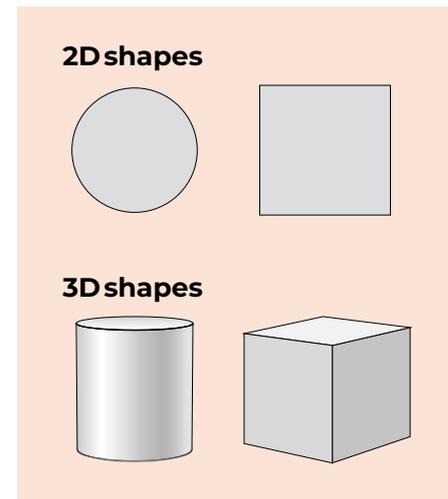
3D SHAPES CAN BE FOUND:

❑ **Find 3D shapes** in the classroom or community. For example, a box or book could be a cuboid, sugar cubes could be cubes, and a tin can could be a cylinder.
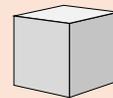
Using Geometry Language

Different countries use different names for shapes and their properties. Within a single country, there are often different words used in the language of instruction and in local languages.

When children first learn to identify, sort, and describe shapes, they should be encouraged to use their own words, including non-math words. For example, they may describe a cuboid as a "box" or even a "shape with corners." Encourage them to use their own words and creativity, but make sure they describe shapes accurately.

What would you call this?

Examples:
Math words: cuboid, rectangular prism
Non-math words: box, block

When you introduce math words to children, you may want to introduce the words in both the language of instruction and the local languages. Encourage and help children to start using math words themselves. Be careful to introduce only those words that are appropriate for students' level of understanding and the curriculum. For example, in the early primary grades, you could introduce the "faces" of 3D shapes but not the "vertices."

Connections with Other Mathematical Concepts

MEASUREMENT

Geometry is closely related to measurement. In the early grades, children learn to measure, compare, and discuss the distance between objects, the length of objects, the area or size of shapes, and the volume of containers. Having a good understanding of the properties of 2D and 3D shapes will support them as they learn to measure.

FRACTIONS

Geometry can help students understand fractions, which can be represented using shapes that are divided into equal parts. Module 6 explores how shapes can be used to teach fractions.

OTHER TOPICS AND SUBJECTS

Geometry has many applications, including in other school subjects such as science, technology, art, and music. It also has applications in everyday life and work. For example, geometry is used in many jobs, including in technical and vocational jobs like carpenter, tailor, and electrician. Below are just a few ways that children can apply their geometry skills later on:

- Interpret or draw a map
- Plan a route
- Design a house, furniture, or a dress
- Create art

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