Chapter

9 VOLUME

Across-Grades Progression

Looking Back	Looking Here	Looking Ahead
Grade 2 Chapter 9 **Section 9A 2-D and 3-D Shapes** • 2-D Shapes and Draw 2-D Shapes • 3-D Shapes **Grade 4 Chapter 8** **Section 8A Rectangles and Squares** • Areas and Perimeters of Rectangles and Squares • Find Unknown Sides of Rectangles and Squares **Section 8B Rectangles and Squares** • Areas and Perimeters of Composite Figures	**Grade 5 Chapter 9** **Section 9A Measure and Compare Volumes** **Section 9B Volume of Rectangular Prisms** **Section 9C Volume of Composite Solids** **Section 9D Word Problems: Volume of Solids**	**Grade 6** **Volume and Surface Area** • Volume of a Right Rectangular Prism with Fractional Side Lengths • Real-World Problems: Volume • Right Prisms, Pyramids, and Nets • Surface Area of Right Rectangular Prisms, Triangular Prisms, and Pyramids • Real-World Problems: Nets and Surface Area

Across-Chapters STEAM Project Work

This project spans **Chapters 9** and **10**. Students are given an opportunity to make connections between engineering and mathematics as they design a house for their families. In Chapter 9, students will research the process of designing a house. They will create a 3-D model using boxes and sketch the 3-D model on grid paper. Next, they will estimate the dimensions of the house and calculate its volume. In Chapter 10, students will use square grid paper to design the floorplan of a room in the house. Students will use different quadrilaterals to show the different parts of the room. Then, they will classify the quadrilaterals. Finally, students will share their 3-D design and floorplan with their classmates.

Readiness | Engagement | Mastery

Lesson 1

Chapter Opener (page 137)

20 minutes

In this chapter, students learn the concept of volume and how it can be used to solve real-world problems. The picture provides a familiar context for students to explore how the concept of volume is applicable to real life.

- You may use the Interactive Class Presentation to facilitate discussions and promote interactions.
- Display the picture. Invite students to share what they see.
  a family of three looking for storage boxes
- Group students in pairs or small groups. Encourage students to discuss the picture and the questions on the page.
- You may facilitate discussions with these questions. Observe student discussions and pay attention to the language they use.

What is happening in the picture? A family is deciding on a storage box. **How do the boxes differ?** They have different dimensions; the blue box is longer than the green box; the green box is taller than the blue box. **How are the boxes similar?** Both are rectangular prisms. **How would you determine which box has a greater volume?**

English Language Support

Encourage students to review the concept of area and 3-D shapes as a way to build the concept of volume using these sentence frames.

Area of rectangles can be found by multiplying the _____ and _____. length; width

A _____ is a 3-D solid that has rectangles as its faces. rectangular prism

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Promoting Growth

Before beginning the chapter opener, have students explore the geometry concepts using rectangles and 3-D solids. Invite students to consider the attributes of rectangles and how they are used to create a rectangular prism using connecting cubes.

Extension

Invite students to design their own toy box that they think would be best to hold toys using dimensions of a room and the dimensions of common toys.

Lesson 2

9A Measure and Compare Volumes

Focus Question

How can you recognize and compare the volume of solids in cubic units?

I CAN

- I can recognize volume of solids in cubic units.
- I can compare volume of solids in cubic units.

Vocabulary

- volume
- cubic unit

Mathematical Practice(s)

- 4 Model
- 6 Use Math Language
- 7 Use Structure

Material(s)

- I set of geometric solids (cubes) for the teacher
- I set of connecting cubes per pair or small group

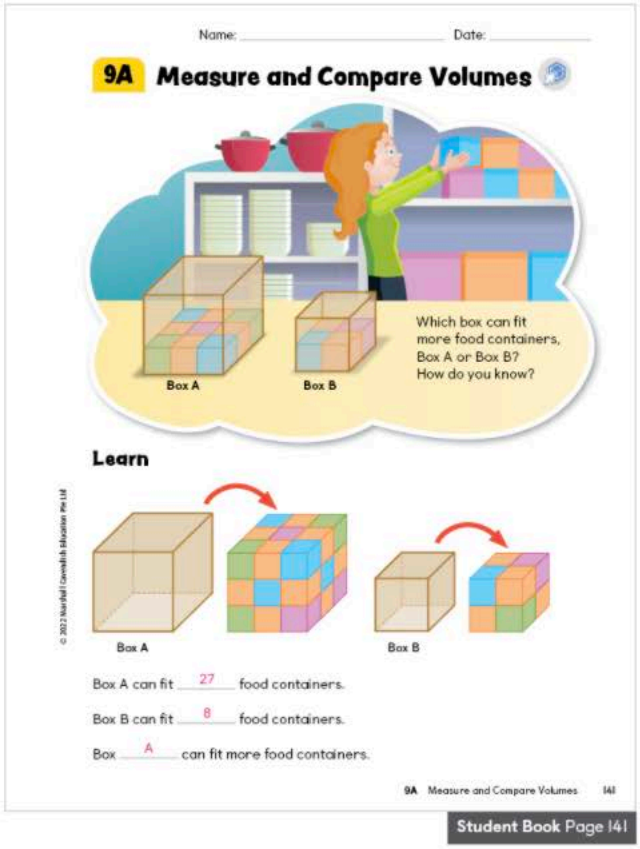
MEASURE AND COMPARE VOLUME IN CUBIC UNITS
(pages 141 to 146)

Lesson Opener

Task (page 141) — 10 minutes

- You may use the appropriate digital manipulatives to support teaching and learning throughout the lesson(s) in Section 9A.
- Group students in pairs or small groups. Provide them with connecting cubes.
- Have students work on the task. Observe student discussions.
- After students have attempted the task, use the following prompts to facilitate a class discussion. Pay attention to the language students use.

What were you asked to do? find which box can pack more food containers **What do you notice about the food containers?** All the food containers are cubes of the same size. **What do you notice about the boxes?** They are also cubes but larger in size. **How did you determine which box can pack more food containers?** Box A looked bigger; 9 food containers could fit into the bottom of Box A and only 4 food containers could fit into the bottom of Box B. **How did you know for sure?** I filled each box with food containers, then count the number of food containers in each box.


Name: _____ Date: _____

9A Measure and Compare Volumes

Learn

Box A can fit 27 food containers.

Box B can fit 8 food containers.

Box A can fit more food containers.

9A Measure and Compare Volumes 141

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Lesson Development

Learn (page 141) — 10 minutes

- Have students build each figure (Box A and Box B) with connecting cubes.

How many cubes could fit into Box A? 27 **How many cubes could fit into Box B?** 8 **Which box can fit more food containers?** Box A

- Have students discuss other characteristics they notice about the two boxes when filled with cubes.

What can you say about the number of cubes in Box A? There are 9 cubes in a layer and 3 layers of 9 cubes; there are 27 cubes in all. **What can you say about the number of cubes in Box B?** There are 4 cubes in a layer and 2 layers of 4 cubes; there are 8 cubes in all. **What are other ways you can use to find the number of food containers in Box A without counting one by one?** I can multiply the number of unit cubes that can fit along each edge of the box.

continued

Additional Support

Show students a cube. Review what students know about cubes and the terms "face" and "edge."

Learn Together (pages 142 to 144) 15 minutes

- Group students in pairs or small groups to answer Questions 1 to 4.
- **QUESTION 1** requires students to recognize and compare the volume of solids using unit cubes.
- Invite students to build the two solids using connecting cubes.

How many unit cubes build Solid A? 8 How do you know?
I counted them; it is made up of 2 layers of 4 unit cubes.
How many unit cubes build Solid B? 8 How do you know?
I counted them; there are 4 unit cubes on the bottom row, 3 unit cubes on the middle row, and 1 unit cube on the top row.

- Encourage students to build as many other solids as possible using 8 unit cubes.
- **QUESTION 2** requires students to recognize the volume of solids using unit cubes.
- Display Solid C on the Student Book page.

How many unit cubes do you see when you look at Solid C? 6

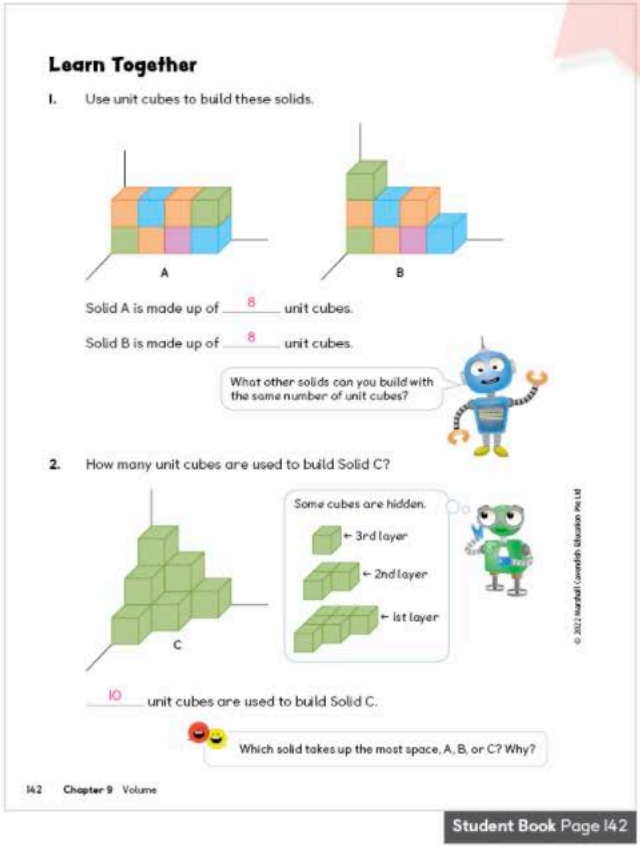
- Prompt students to build Solid C with the connecting cubes.

How many unit cubes did you use to build Solid C? 10
How many cubes are on the first layer? 6 Second layer? 3 Third layer? 1

- Highlight to students that when they look at some solid figures, some of the unit cubes may be hidden.

Have students discuss the question and share their thinking.

How many unit cubes made up Solid A? 8 Solid B? 8 Solid C? 10 Which solid takes up the most space? Solid C Why? Solid C is made up of the greatest number of unit cubes.



Learn Together

1. Use unit cubes to build these solids.

A B

Solid A is made up of 8 unit cubes.

Solid B is made up of 8 unit cubes.

What other solids can you build with the same number of unit cubes?

2. How many unit cubes are used to build Solid C?

C

Some cubes are hidden.
← 3rd layer
← 2nd layer
← 1st layer

10 unit cubes are used to build Solid C.

Which solid takes up the most space, A, B, or C? Why?

142 Chapter 9 Volume

Student Book Page 142

Name: _____ Date: _____

Activity!

List some objects in your classroom that take up more space than your Math book. Which object takes up the most space?

My school bag takes up more space than my Math book. My school bag has a greater volume than my Math book!

The volume of a solid is the amount of space it occupies.

Answers vary. Example: bookcase

The _____ takes up the greatest amount of space.
It has the greatest volume.

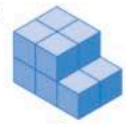
3. The edge length of a unit cube is 1 unit.

The volume of the unit cube is 1 cubic unit.

Student Book Page 143

4. Fill in the blanks.

(a)

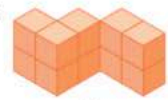


D

Solid D is made up of 10 unit cubes.

Its volume is 10 cubic units.

(b)

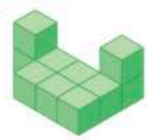


E

Solid E is made up of 10 unit cubes.

Its volume is 10 cubic units.

(c)



F

Solid F is made up of 10 unit cubes.

Its volume is 10 cubic units.

Different solids can have the same volume.

Student Book Page 144

Activity! (page 143) 10 minutes

- Have students list at least three objects in the classroom that take up more space than their Math book.
- Invite students to share their lists and compile the list on the board.
- Point out that the amount of space an object occupies is its volume.
- Write "volume" on the board.

Which object in your list or the list on the board do you think takes up the most amount of space?

- Have students complete the sentence frame in the book.

- **QUESTION 3** requires students to recognize the volume of solids made up of unit cubes.
- Hold up a cube in front of the class.
- Lead students to see that each edge of the cube is 1 unit.
- Point out that they can measure volume in cubic units.

What is the volume of the unit cube? 1 cubic unit

English Language Support

The term "volume" has three different uses in English. It can be used to describe a book like the students' math book – Volume A and Volume B. It can be used to describe how loud something is – the volume on the TV. In math, the volume of a solid describes the amount of space it occupies.

- **QUESTION 4** requires students to compare the volume of solids made up of unit cubes.
- Have students visualize the number of unit cubes in each solid, then build it with the connecting cubes.

What do you notice about the number of unit cubes required to build each solid? All three solids require 10 unit cubes each. **What do you know about the volume of each solid?** The volume of each solid is 10 cubic units. **What can you say about the different solids?** They have the same volume.

continued

Caution

Volume and capacity are two concepts that are often confused. Capacity refers to the amount that a container can hold while volume refers to the amount of space an object takes up (or the volume of liquid in a container).

Extension

Challenge students to build their own composite solids with unit cubes. Then, have them draw the solids they built on isometric dot paper.

Readiness | Engagement | **Mastery**

Lesson Debrief

- Conclude the lesson and facilitate students' reflection by asking students to answer the **Focus Question** and share their thinking.

? Focus Question

How can you recognize and compare the volume of solids in cubic units?

- Extend the discussion by posing the following questions.

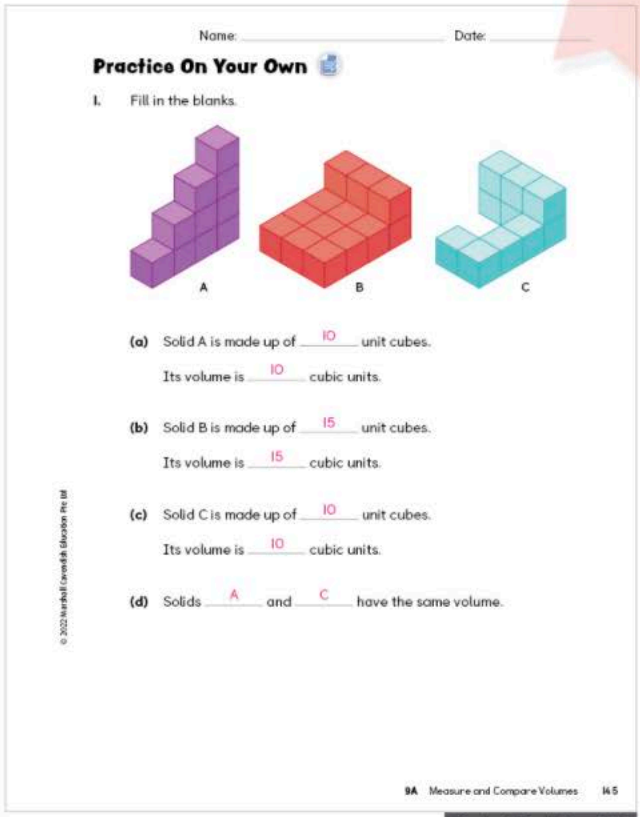
What can you say about a solid that takes up more space than another solid? How do you measure the volume of a solid in cubic units?

Promoting Growth

To encourage and support students to persevere in problem solving and maintain a learning mindset:

- Allow students time to reflect on what they have learned and ask questions about what they may be unsure of.
- Encourage students to share how they overcome a difficulty in the process of learning.
- Provide students with this prompt: Build a solid using 12 unit cubes and describe its shape and volume.
- Have students write a journal entry.

- Display this lesson's **I CAN** statement(s) for students to reflect on their learning.
  - o I can recognize volume of solids in cubic units.
  - o I can compare volume of solids in cubic units.



Name: _____ Date: _____

Practice On Your Own

1. Fill in the blanks.

A B C

(a) Solid A is made up of 10 unit cubes.
Its volume is 10 cubic units.

(b) Solid B is made up of 15 unit cubes.
Its volume is 15 cubic units.

(c) Solid C is made up of 10 unit cubes.
Its volume is 10 cubic units.

(d) Solids A and C have the same volume.

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Practice On Your Own (pages 145 and 146) 15 minutes

If you would like the questions to be auto-graded, refer students to online **Practice On Your Own** as a lesson check. If you want students to show their work, have them do so in the Student Book.

- **QUESTIONS 1(a)** to **1(c)** assess students' ability to recognize the volume of solids in cubic units.
- **QUESTION 1(d)** assesses students' ability to compare the volume of solids in cubic units.

Additional Support

When counting unit cubes to determine volume, some students may not include cubes that are hidden from view. Provide students with connecting cubes and have them build each solid. Then, count the number of unit cubes used.