

# Teacher Edition



Fourth Edition



Part  
**1**

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## Lesson Features

Objectives point out the skills taught in the lesson.

The Lesson Focus prepares the students for what they will learn in the lesson.

A variety of activities allows the students to practice analytical thinking and see math at work in real-life contexts.

The Materials section lists items that are used in the lesson.

Teach for Understanding and Check for Understanding provide background information and questions to effectively engage the students in learning the math concepts for each lesson. Lessons incorporate manipulatives to promote a problem-solving approach that develops critical-thinking skills.

### Lesson 148 Worktext pages 272, 285

#### Objectives

- Identify the problem that needs to be solved
- Define the terms *prosthesis* and *prosthetic device*
- Design a LEGO prosthesis
- Use provided materials to build a prosthesis
- Test the prosthesis

#### Teacher Resources

- 14 *Engineering Design Process*

#### Other Teaching Aids

- For each group:
  - Several LEGO bricks (1 x 2, 2 x 2 x 2 x 4)
  - Drinking straws
  - Masking tape
  - Paper clips
  - Rubber bands
  - String
- Video of a child with a 3-D printed prosthesis (optional)

#### Teach for Understanding

##### Lesson Focus

In this lesson you will use provided materials to design and build a prosthetic index finger.

**Identify the problem that needs to be solved; define the terms *prosthesis* and *prosthetic device***

- Display the *Engineering Design Process* page. Review the process as needed.

##### Ask

- Read Worktext page 272 aloud. Discuss the need for artificial limbs or fingers for those who were born without them or who have had them amputated.

Consider showing a video of a child with a 3-D printed prosthesis.

Suppose you have a friend who has lost the first two segments of his index finger. How could you help him? I could design something to take the place of his missing finger segments.

- Write "prosthesis" and "prosthetic device" for display. Explain that when a person is missing a body part or has a body part that does not properly function (such as a hand, leg, heart valve, or even a tooth), it can sometimes be replaced with an artificial part, which may be called a prosthesis or a prosthetic device.



#### Design a LEGO Prosthesis

"Something is off, but I can't get a finger on it." "Give me your hand! Someone see that! The prosthesis just means that there was something he couldn't figure out. But what if you literally couldn't get a finger on something because you didn't have any fingers?"

Many children are born each year with part of an arm or hand missing. Simple things like picking up a pencil or catching a ball with that hand can be difficult or even impossible. And other kids can be natural to someone who is different.

Take Adam, for example. Adam was born without fingers on his left hand. Kids at school didn't want to hold his hand. They said he had two words. Adam's dad searched for a way to help him. That's when he learned about 3-D printed prostheses. Within a few days Adam had a cool index hand!

A 3-D printed prosthetic hand is made after the human hand, a marvelous Creator-designed mechanism. Though it's not the same as a real hand, a prosthesis opens up a whole new world for someone who lacks a functional hand.



Allow students to share examples of prostheses that they are personally familiar with.

**Why might a prosthesis be helpful?** It can allow a person who is missing a part of his body to do things he could otherwise not do.

**What are some potential disadvantages of a prosthesis?** It might not allow a person to do all the things he could do if he had a healthy, living body part or to do them as well; it might be uncomfortable; it might be expensive; it might wear out and need to be replaced.

Point out that the most effective prostheses function as much like the human body as possible.

- Remind the students that modeling with math is using numbers and symbols to explain, describe, or represent something in the world. Invite them to suggest ways that math modeling may be used in constructing a prosthesis. Answers may include measuring the body to determine what size the prosthesis should be, calculating to ensure that the parts of the prosthesis will fit, describing the prosthesis's construction or function with equations, or using the measurements and calculations with a computer program to design a prosthesis that could be printed with a 3-D printer.

- Explain that for this chapter's STEM activity, the students will model the process of building a functional prosthesis from provided materials, including at least 1 LEGO brick. The prosthesis should allow its wearer to grasp and pick

Involving the students in interactive learning through discussion encourages them to construct reasonable proof for their solutions.

Discussion of real-life math problems helps students relate math to biblical worldview truths.

Reduced Worktext and Activities pages provide answers in magenta. Use these pages to evaluate student progress and to determine where more guidance is needed.

**Design a LEGO prosthetic**

**Imagine**

- Arrange the students in groups. Distribute the listed supplies to each group. Encourage the students to begin thinking of how they could use the supplies to model a part of a finger.
- Direct the groups to discuss their ideas for a prosthetic device to replace the first two segments of their friend's index finger. Remind them that the prosthetic should allow their friend to grasp and pick up a  $2 \times 4$  LEGO brick with his thumb and the prosthetic.

Bend your index finger inward to touch your palm to show the students where their prosthetic will attach to the index finger (head of the proximal phalanx).

*What questions do you need to ask? Possible answers: How long should my prosthetic be? How will it attach to my friend's hand? How will it work with his thumb to pick up a LEGO brick?*

- Instruct the students to record their ideas for an index finger prosthetic in problem 2 on the Worktext page.

**Plan**

- After the students have recorded their ideas, direct each group to circle their best idea(s) to complete problem 3 on the Worktext page.

**Use provided materials to build a prosthetic; test the prosthetic**

**Create, Improve**

- Allow time for the groups to construct a working prosthetic, using their best idea. Emphasize that they may choose to modify their design as they work to improve it.

As they work, direct the students to record in problem 4 any notes that will help them describe the construction of their prosthetic, using pictures or words.

- When their prosthetic is complete, instruct each group to record in problem 5 the size and arrangement of the LEGO bricks and other constructions in their prosthetic, using pictures, numbers, and words.
- Direct each group to test their prosthetic to see if it will grasp and pick up a  $2 \times 4$  LEGO brick. If time permits, allow groups to demonstrate the operation of their prostheses for the class.
- Direct the groups to complete problem 6 on the Worktext page.
- Collect the prostheses to use in Lesson 149.

Group work promotes collaborative learning. Students learn by working together as a class and sometimes by working in smaller groups.

up a  $2 \times 4$  LEGO brick, using the prosthetic and his thumb on the same hand. The students' designs may also involve the use of the other hand (e.g., to manipulate string to imitate muscles and tendons controlling the prosthetic's movement).

- Direct the students to complete Worktext problem 1.

To assist the students as they develop their prostheses, you may choose to guide a discussion about how the fingers move, what muscles and tendons are involved, etc. Consider sharing visuals to assist comprehension (perform keyword search "human hand bones" or "human hand muscles").

Chapter 14 • Geometry: Surface Area & Volume

Lesson 148 597

## Review Features

### Daily Review

#### Practice and Review Activities

Practice and Review activities are included in every lesson (Teacher Edition) so that the students are continually practicing the essential skills from this grade level and furthering their understanding. These activities may be scheduled for any time during the day.

#### Daily Reviews

A section of Daily Review exercises is included for each chapter (TeacherToolsOnline.com). These exercises review a concept taught or practiced in an earlier chapter or in fourth grade.

#### Activities

The Activities workbook provides two pages of optional practice for most lessons. The first page reinforces the Worktext lesson and may be used to assess daily grades. The second page provides a spiral review of concepts as well as standards-based strategies and skills.

### Review by Chapter

#### Chapter Sequence

The chapter sequence helps the students develop a deeper conceptual knowledge of the core topics presented at this grade level. Chapters in fractions and division, for example, are spaced

out to allow connections to be made and to enable the students to review and build upon previously taught concepts as they develop new math skills.

#### Chapter Review

The Chapter Review provides an overview of the main concepts of the chapter. Chapter Review pages can be used as a study guide for the Chapter Test.

#### Cumulative Review

The Cumulative Review pages are located at the end of each chapter in the Activities book. Use these pages to review math concepts and evaluate which essential skills need reteaching. A *Cumulative Review Answer Sheet* (Teacher Resources) is available for your students to practice the standardized test format.

#### Fact Reviews

Fact Reviews (TeacherToolsOnline.com) are provided to help your students work toward fact memorization. Daily fact practice should include a variety of practice methods, such as using flashcards, games, and written practice. Speed drills are available at AfterSchoolHelp.com.

### Review in the Classroom

If available, computer-based apps and games may be used for review. Visit TeacherToolsOnline.com for additional review ideas.

## New to This Edition

### STEM

Most even-numbered chapters feature special lessons that emphasize science, technology, engineering, and math (STEM). Each STEM lesson is intended to pique students' interest as they collaborate to solve a problem through inquiry, active learning, and creativity.

### Biblical Worldview Shaping

Biblical worldview themes are specifically highlighted in certain Worktext questions and lesson objectives (indicated by **BWS**). These sections will help students learn to apply a biblical worldview of mathematics to real-life problems.

### Chapter Information

This section at the beginning of each chapter indicates the type of foundational knowledge the chapter builds upon and provides helpful information pertaining to the chapter.

### Lesson Focus

For every lesson, this book offers a Lesson Focus, which is to be conveyed to your students before the lesson begins. Students should discuss what they have learned before they begin their practice on the Worktext pages.

### Problem-Solving Emphasis

Processing word problems successfully will help your students become lifelong problem solvers. Ask the students to listen for what action is taking place and whom the problem is about as you read each word problem the first time. As you reread the word problem one sentence at a time, encourage your students to picture the problem, write an equation, solve the problem, and then explain how their answer makes sense. Finally, help the students craft a summary sentence to explain the solution.

### Reasoning and Critical Thinking

The lessons establish a pattern of asking students to explain their answers or reasoning. It is expected that students will give their reasoning for all answers where appropriate. A gear icon (⚙️) identifies higher-order thinking questions. Supply any prompts or background needed to guide the student to the answer.

### Collaborative Learning

Students sometimes work in pairs or groups, allowing collaboration and interaction among peers. For optimal learning for all students, each group should include students with varying strengths and abilities.