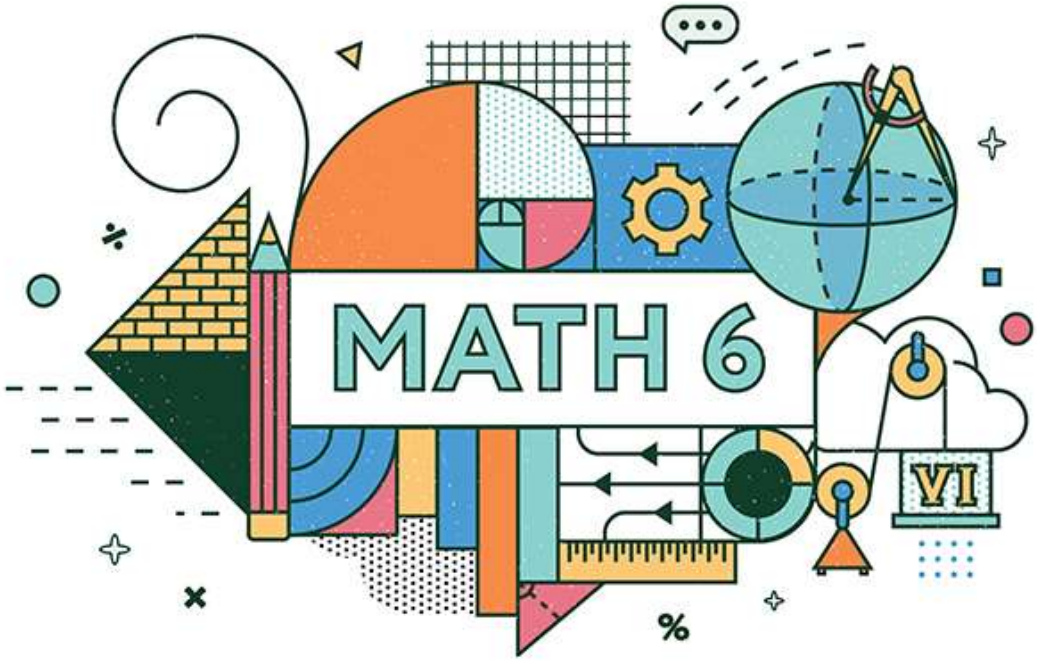
Teacher Edition



Fourth Edition

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Part
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BIBLICAL WORLDVIEW SHAPING

IN *Math 6*, FOURTH EDITION

What is math all about? Is it just numbers and symbols? Math is not just about these characters that represent math. Math is about numbers in space in God's creation. Using the four biblical worldview themes below, students will begin learning to view mathematics biblically.

Math 6, Fourth Edition, answers the questions posed below to help students begin to think about math the way that God intends.

Knowledge about Math

God shows us what the world is like in the Scriptures and in creation. Math is a human activity that enables people to explore God's creation. Some people want to think that math can give them the most complete and reliable knowledge of the world around them.

- How did God make math possible for humans?
- How does Scripture inform a Christian's view of the reliability of math?

Ch 1	Ch 5	Ch 9	Ch 14
E(3), R	E(5), EV	E, EV(3)	E(2), A, F

KEY
(for tables)

R: Recall biblical teaching.

E: Explain biblical teaching.

EV: Evaluate controversial concepts.

F: Formulate a biblical understanding of a controversial concept.

A: Apply a biblical understanding to life.

The number in parentheses indicates the number of times a specific application of a theme occurs in the chapter.

Modeling with Math

Mathematical modeling is a human way of understanding and representing the world God made. Sometimes, however, people put too much confidence in math models. Some people even believe that math models are the only really reliable way to find the truth.

- What do math models require in order to be useful?
- How should a Christian respond to someone who claims that math is completely objective?

Ch 2	Ch 7	Ch 10	Ch 17
R(3), E	E(3)	R, E, EV	E(3), F

Service with Math

People uniquely bear the image of God and therefore they possess the ability to use math to serve others. Math enables people to serve others as God intended. However, because all people are sinful, they naturally learn and use math in selfish ways and for distorted purposes.

- How can a Christian use math to serve others?
- What must always guide the way a Christian uses math?

Ch 3	Ch 8	Ch 12	Ch 15
E(4)	E(4)	E(2), A	E(3), F, A

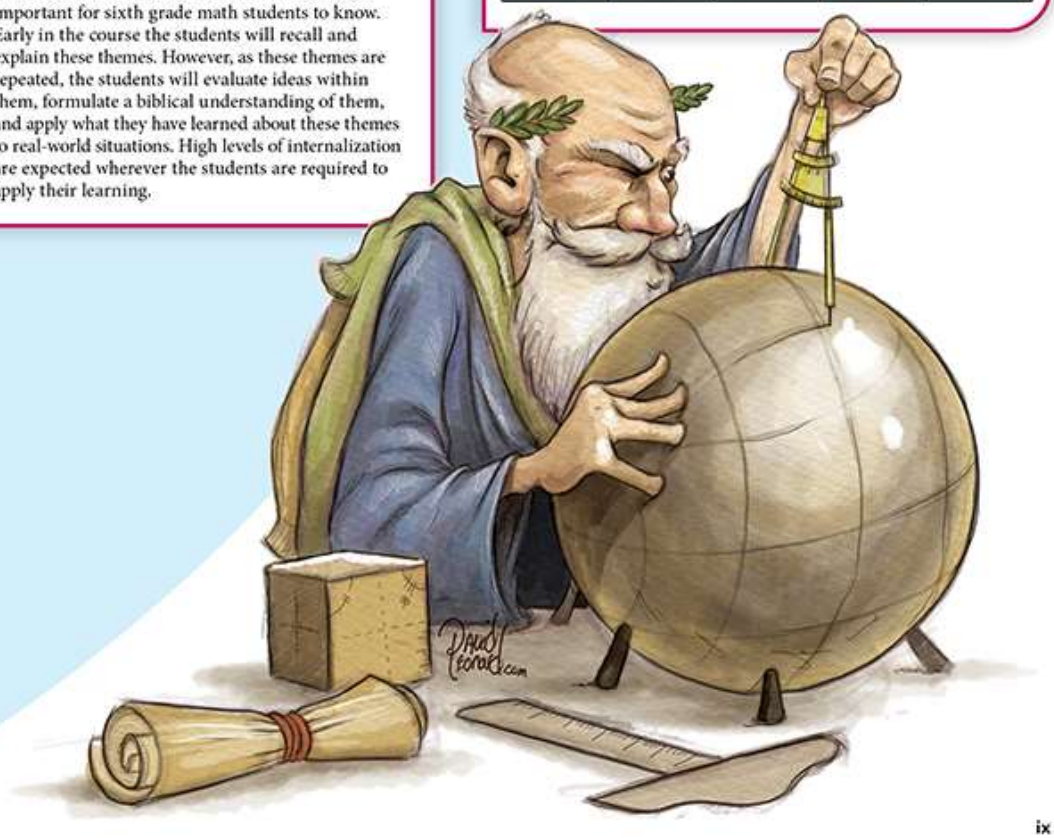
Design in Math

As we use math to solve problems, we discover that our world has been carefully designed. God intends for us to praise Him for His good and wise design of creation. But many people argue that the appearance of design seen in mathematical patterns resulted from natural processes, not God.

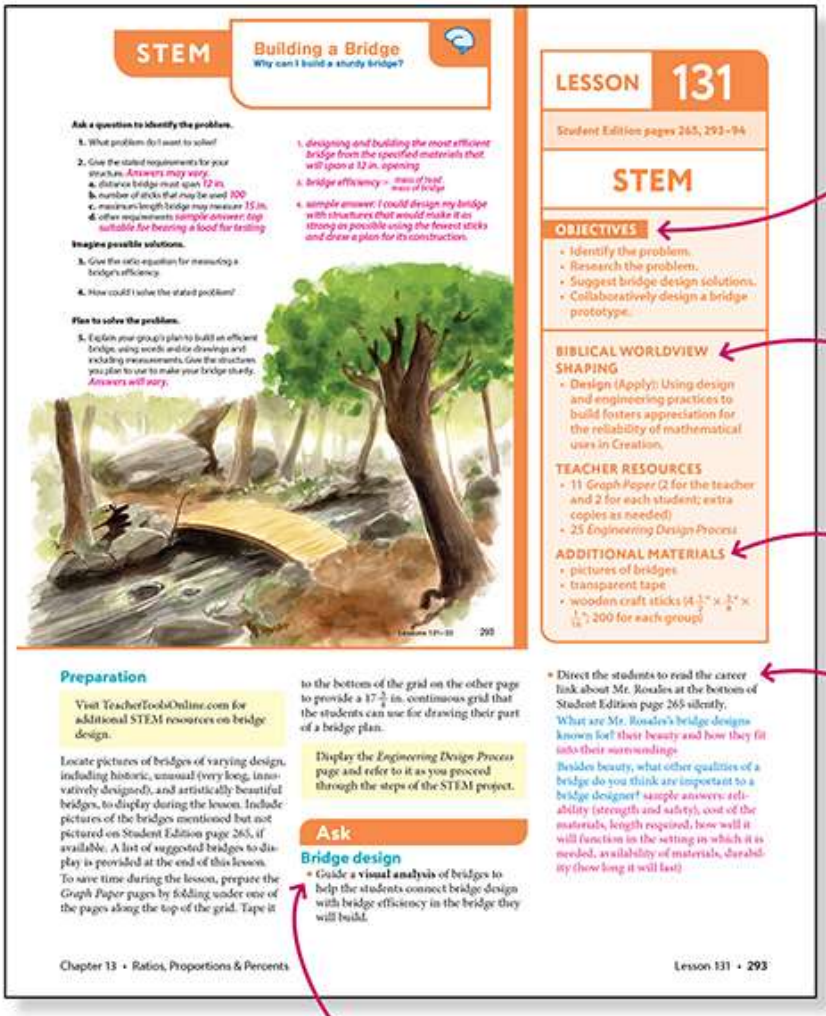
- How should a Christian explain the mathematical order found in Creation?
- What role does the Bible play in helping us understand God's design of creation?

Ch 4	Ch 6	Ch 11	Ch 13	Ch 16
R, E(2)	E(3)	R, E, EV, F	R, E(2), EV, A	R, E, F

Above are the biblical worldview themes that are important for sixth grade math students to know. Early in the course the students will recall and explain these themes. However, as these themes are repeated, the students will evaluate ideas within them, formulate a biblical understanding of them, and apply what they have learned about these themes to real-world situations. High levels of internalization are expected wherever the students are required to apply their learning.



LESSON FEATURES



STEM

Building a Bridge

Why can I build a sturdy bridge?

Ask a question to identify the problem.

1. What problem do I want to solve?
2. Give the stated requirements for your structure. *Answers may vary.*
   a. distance bridge must span *12 in.*
   b. number of sticks that may be used *100*
   c. maximum length bridge may measure *15 in.*
   d. other requirements *sample answer: egg suitable for bearing a load for testing*

Imagine possible solutions.

3. Give the ratio equation for measuring a bridge's efficiency.
4. How could I solve the stated problem?

Plan to solve the problem.

5. Explain your group's plan to build an efficient bridge, using words and/or drawings and including measurements. Give the structures you plan to use to make your bridge sturdy. *Answers will vary.*

1. *designing and building the most efficient bridge from the specified materials that will span a 12 in. opening*
3. *bridge efficiency* = $\frac{\text{mass of load}}{\text{mass of bridge}}$
4. *sample answer: I could design my bridge with structures that would make it as strong as possible using the fewest sticks and draw a plan for its construction.*

Lesson 131 • 293

LESSON 131

Student Edition pages 265, 293–94

STEM

OBJECTIVES

- Identify the problem.
- Research the problem.
- Suggest bridge design solutions.
- Collaboratively design a bridge prototype.

BIBLICAL WORLDVIEW SHAPING

- Design (Apply): Using design and engineering practices to build fosters appreciation for the reliability of mathematical laws in Creation.

TEACHER RESOURCES

- 11 *Graph Paper* (2 for the teacher and 2 for each student; extra copies as needed)
- 25 *Engineering Design Process*

ADDITIONAL MATERIALS

- pictures of bridges
- transparent tape
- wooden craft sticks ($4\frac{1}{2}'' \times \frac{3}{4}'' \times \frac{1}{16}''$; 200 for each group)

Preparation

Visit TeacherToolsOnline.com for additional STEM resources on bridge design.

Locate pictures of bridges of varying design, including historic, unusual (very long, innovatively designed), and artistically beautiful bridges, to display during the lesson. Include pictures of the bridges mentioned but not pictured on Student Edition page 265, if available. A list of suggested bridges to display is provided at the end of this lesson.

To save time during the lesson, prepare the *Graph Paper* pages by folding under one of the pages along the top of the grid. Tape it to the bottom of the grid on the other page to provide a $17\frac{1}{4}$ in. continuous grid that the students can use for drawing their part of a bridge plan.

Display the *Engineering Design Process* page and refer to it as you proceed through the steps of the STEM project.

Ask

Bridge design

- Guide a **visual analysis** of bridges to help the students connect bridge design with bridge efficiency in the bridge they will build.
- Direct the students to read the career link about Mr. Rosales at the bottom of Student Edition page 265 silently.

  What are Mr. Rosales's bridge designs known for? their beauty and how they fit into their surroundings

  Besides beauty, what other qualities of a bridge do you think are important to a bridge designer? sample answers: reliability (strength and safety), cost of the materials, length required, how well it will function in the setting in which it is needed, availability of materials, durability (how long it will last)

Chapter 13 • Ratios, Proportions & Percents

Lesson 131 • 293

Objectives point out the skills taught in the lesson.

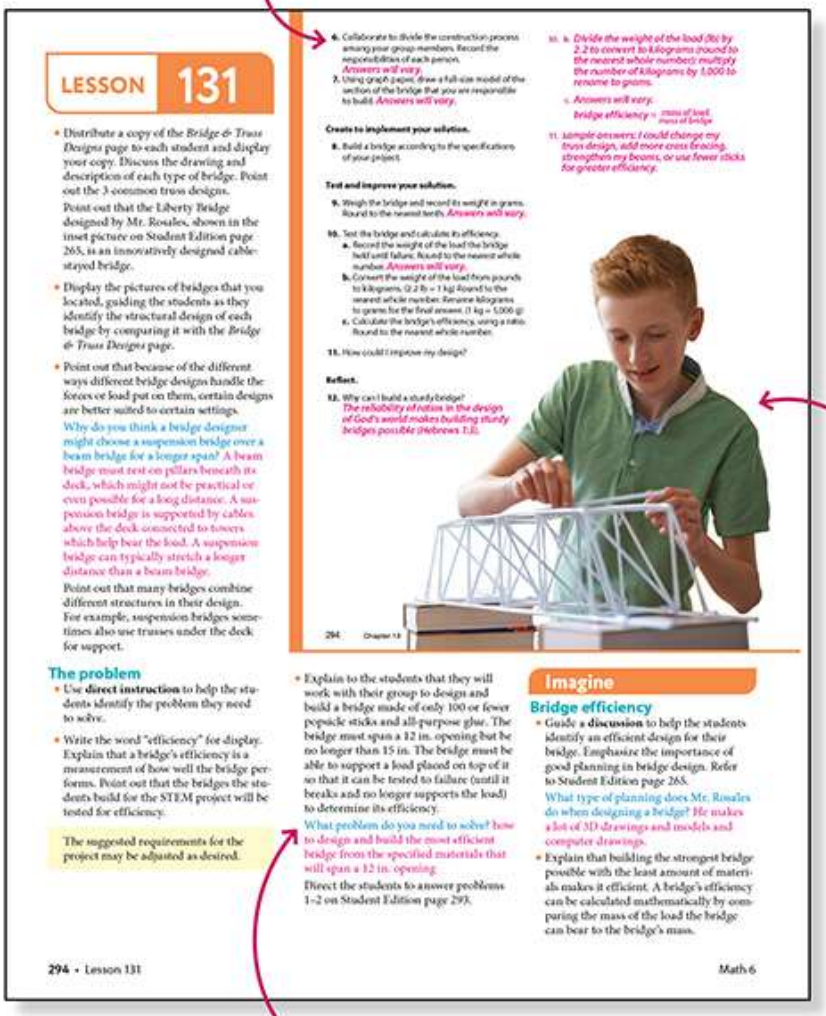
Discussion of real-world math problems helps students relate math to **biblical worldview truths.**

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

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

Instructional strategies provide the means for presenting educational content.

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



LESSON 131

- Distribute a copy of the *Bridge & Truss Designs* page to each student and display your copy. Discuss the drawing and description of each type of bridge. Point out the 3 common truss designs.

  Point out that the Liberty Bridge designed by Mr. Rosales, shown in the inset picture on Student Edition page 265, is an innovatively designed cable-stayed bridge.
- Display the pictures of bridges that you located, guiding the students as they identify the structural design of each bridge by comparing it with the *Bridge & Truss Designs* page.
- Point out that because of the different ways different bridge designs handle the forces or load put on them, certain designs are better suited to certain settings.

  Why do you think a bridge designer might choose a suspension bridge over a beam bridge for a longer span? A beam bridge must rest on pillars beneath its deck, which might not be practical or even possible for a long distance. A suspension bridge is supported by cables above the deck connected to towers which help bear the load. A suspension bridge can typically stretch a longer distance than a beam bridge.

  Point out that many bridges combine different structures in their design. For example, suspension bridges sometimes also use trusses under the deck for support.

The problem

- Use **direct instruction** to help the students identify the problem they need to solve.
- Write the word "efficiency" for display. Explain that a bridge's efficiency is a measurement of how well the bridge performs. Point out that the bridges the students build for the STEM project will be tested for efficiency.

The suggested requirements for the project may be adjusted as desired.

6. Collaborate to divide the construction process among your group members. Record the responsibilities of each person.
   Answers will vary.
7. Using graph paper, draw a full-size model of the section of the bridge that you are responsible to build. *Answers will vary.*

Create to implement your solution.

8. Build a bridge according to the specifications of your project.

Test and improve your solution.

9. Weigh the bridge and record its weight in grams. Round to the nearest tenth. *Answers will vary.*
10. Test the bridge and calculate its efficiency.
    a. Record the weight of the load the bridge held until failure. Round to the nearest whole number. *Answers will vary.*
    b. Convert the weight of the load from pounds to kilograms. (2.2 lb = 1 kg) Round to the nearest whole number. Rename kilograms to grams for the final answer. (1 kg = 1,000 g)
    c. Calculate the bridge's efficiency, using a ratio. Round to the nearest whole number.
11. How could I improve my design?

Reflect.

12. Why can I build a sturdy bridge?
    The reliability of nation in the design of God's world makes building sturdy bridges possible (Hebrews 1:3).

10. b. *Divide the weight of the load (lb) by 2.2 to convert to kilograms (round to the nearest whole number); multiply the number of kilograms by 1,000 to rename to grams.*
    c. *Answers will vary.*
    $\text{bridge efficiency} = \frac{\text{mass of load}}{\text{mass of bridge}}$
11. *Sample answers: I could change my truss design, add more cross bracing, strengthen my beams, or use fewer sticks for greater efficiency.*

294 Chapter 13

- Explain to the students that they will work with their group to design and build a bridge made of only 100 or fewer popsicle sticks and all-purpose glue. The bridge must span a 12 in. opening but be no longer than 15 in. The bridge must be able to support a load placed on top of it so that it can be tested to failure (until it breaks and no longer supports the load) to determine its efficiency.

  What problem do you need to solve? how to design and build the most efficient bridge from the specified materials that will span a 12 in. opening

  Direct the students to answer problems 1–2 on Student Edition page 293.

Imagine

Bridge efficiency

- Guide a **discussion** to help the students identify an efficient design for their bridge. Emphasize the importance of good planning in bridge design. Refer to Student Edition page 265.

  What type of planning does Mr. Rosales do when designing a bridge? He makes a lot of 3D drawings and models and computer drawings.
- Explain that building the strongest bridge possible with the least amount of materials makes it efficient. A bridge's efficiency can be calculated mathematically by comparing the mass of the load the bridge can bear to the bridge's mass.

294 • Lesson 131

Math 6

Four **STEM projects** throughout the course emphasize science, technology, engineering, and math.

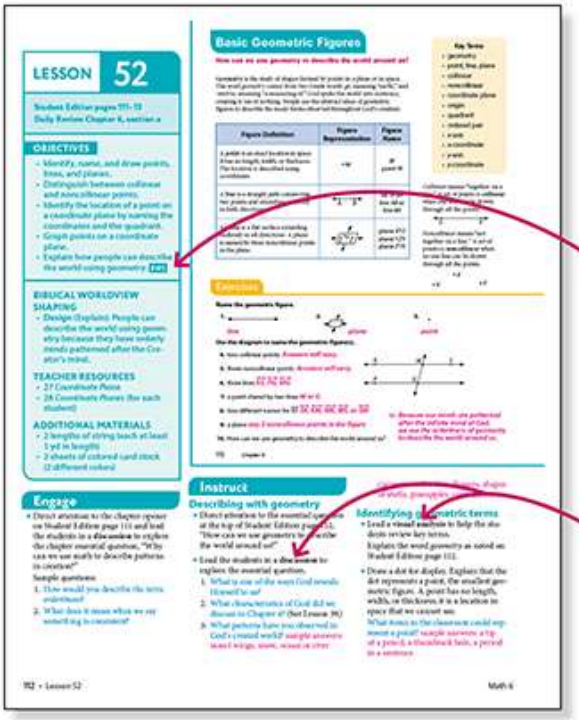
Involving the students in **interactive learning** through discussion encourages them to construct reasonable proof for their solutions.

NEW TO THIS EDITION

STEM
Four chapters (5, 9, 13, and 15) 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 real-world problem through inquiry, active learning, and creativity by following an engineering design process. STEM lessons may be used at any time following the lesson in which they are introduced and are excellent springboards to further student investigation on related topics. Encourage the students to make this a time of learning and experimenting rather than one of producing a polished product. There is much to be learned from the process of trying out ideas.

Essential Questions
Each chapter and lesson have an essential question, which is posed near the beginning of the chapter or lesson and answered at a later point. The sample answers provided can be used to guide the students to answer the essential question on the Student Edition pages.

Math Talks
Most chapters include a Math Talk, a short, open-ended question designed to foster conversations and critical thinking. During this activity, students should share and expand their ideas, listen to others, and deepen their understanding of relevant problems.



Biblical Worldview Shaping
Biblical worldview themes are specifically highlighted in certain lesson objectives (indicated by BWS). These sections will help students learn to apply a biblical worldview of mathematics to real-world problems.

Strategies
Effective teaching strategies are offered in **bold** for each different topic in the flow of the lesson. These may be used to provide variety and to sustain interest within and between the lessons.