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Mathematics Readers—Level 5

This sample includes the following:

Teacher's Guide Cover (1 page)
Table of Contents (2 pages)
How to Use This Product (5 pages)
Lesson Plan (11 pages)
Reader (17 pages)

To Create a World in which Children Love to Learn!

Grade
5

Teacher Created Materials
PUBLISHING

MATHEMATICS READERS

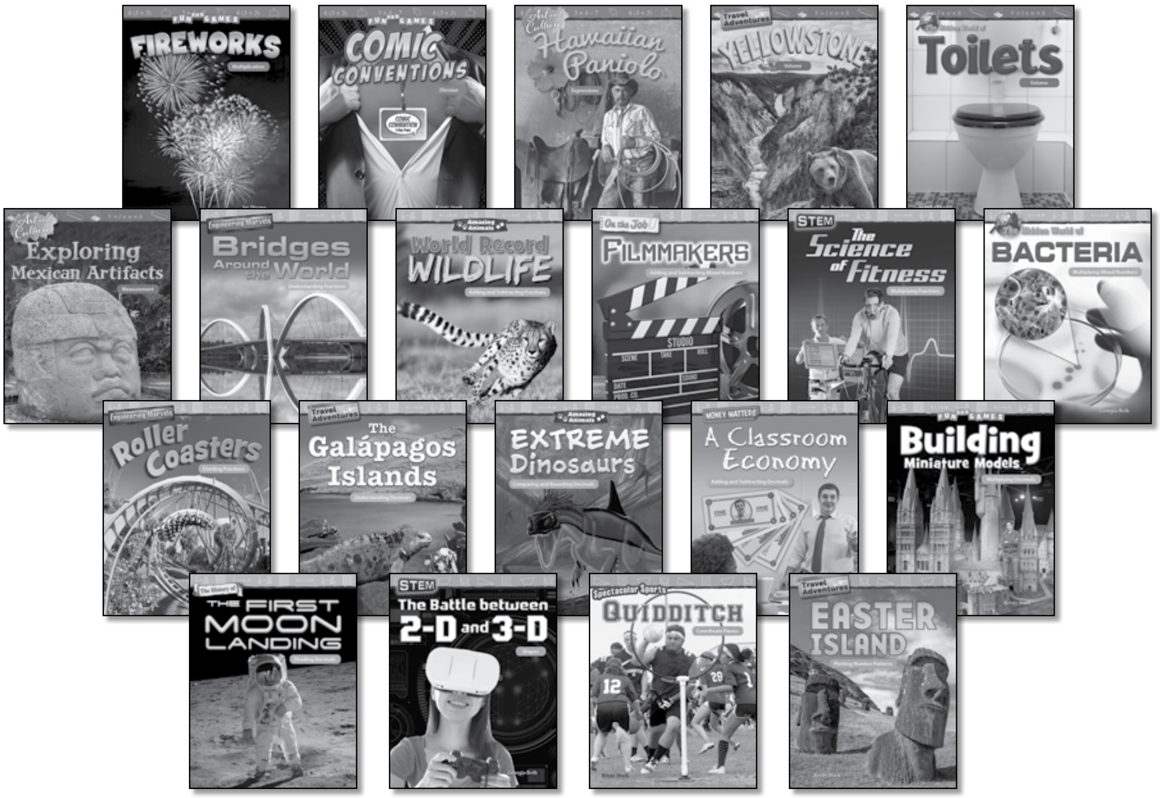
Teacher's Guide

Table of Contents

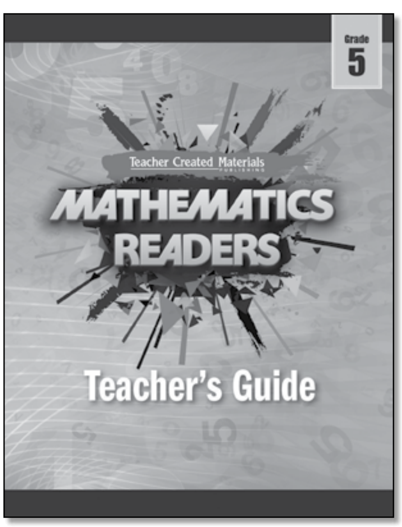
How to Use This Product

Kit Components

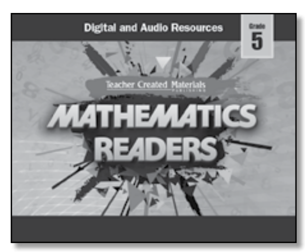
6 copies of 20 books

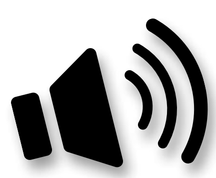


Teacher's Guide



Digital and Audio Resources

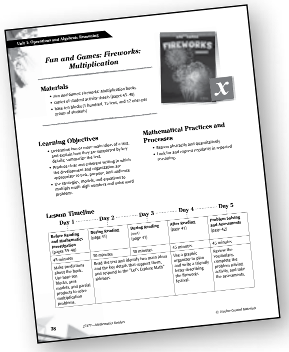




How to Use This Product *(cont.)*

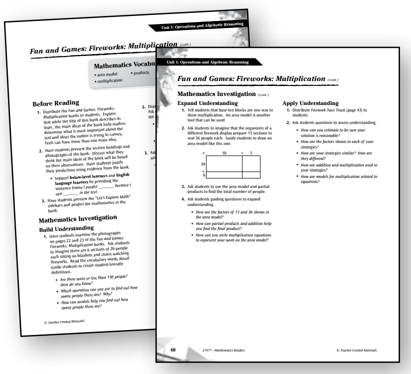
Teacher's Guide

Each five-day lesson sequence is organized in a consistent format for ease of use.



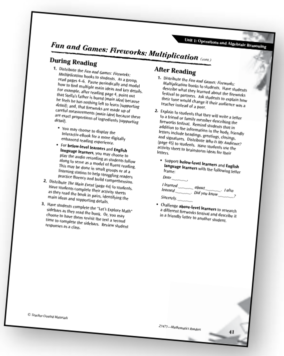
Overview

- The overview page includes learning objectives, a materials list, and a suggested timeline for the lesson.



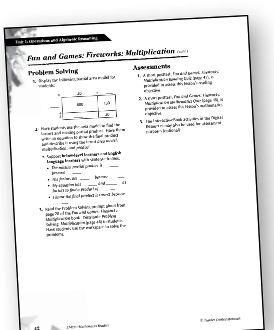
Day 1

- Students are introduced to the book and the math concept or skill.
- Students build, expand, and apply understanding of the math skill with concrete, representational, and abstract activities.



Days 2, 3, and 4

- Students complete reading and writing activities, as well as the "Let's Explore Math" sidebars.



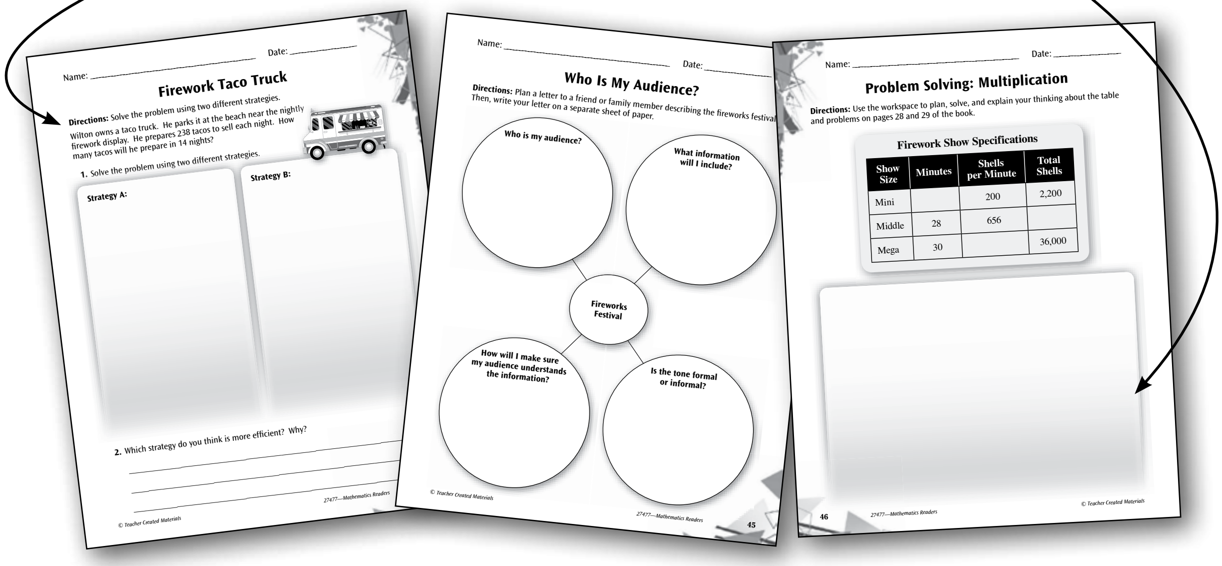
Day 5

- Students take what they've learned and apply it in context in the Problem Solving activity.
- Students take the reading and mathematics assessments.

How to Use This Product *(cont.)*

Student Activity Sheets and Assessments

clear directions and activities that promote higher-order thinking skills



Name: Date:

Firework Taco Truck

Directions: Solve the problem using two different strategies.

Wilton owns a taco truck. He parks it at the beach near the nightly firework display. He prepares 238 tacos to sell each night. How many tacos will he prepare in 14 nights?

1. Solve the problem using two different strategies.

Strategy A: Strategy B:

2. Which strategy do you think is more efficient? Why?

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Name: Date:

Who Is My Audience?

Directions: Plan a letter to a friend or family member describing the fireworks festival. Then, write your letter on a separate sheet of paper.

Who is my audience?

What information will I include?

Fireworks Festival

How will I make sure my audience understands the information?

Is the tone formal or informal?

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Name: Date:

Problem Solving: Multiplication

Directions: Use the workspace to plan, solve, and explain your thinking about the table and problems on pages 28 and 29 of the book.

Firework Show Specifications

Show Size	Minutes	Shells per Minute	Total Shells
Mini		200	2,200
Middle	28	656	
Mega	30		36,000

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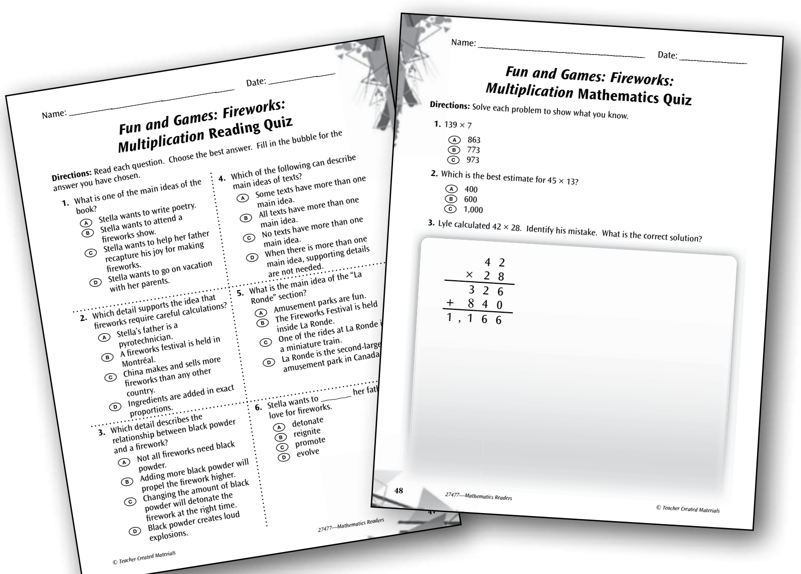
reading and math quizzes with text-dependent questions



Name: Date:

Fun and Games: Fireworks: Multiplication Reading Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

1. What is one of the main ideas of the book?
   - Ⓐ Stella wants to write poetry.
   - Ⓑ Stella wants to attend a fireworks show.
   - Ⓒ Stella wants to help her father recapture his joy for making fireworks.
   - Ⓓ Stella wants to go on vacation with her parents.
2. Which detail supports the idea that fireworks require careful calculations?
   - Ⓐ Stella's father is a pyrotechnician.
   - Ⓑ A fireworks festival is held in Montréal.
   - Ⓒ China makes and sells more fireworks than any other country.
   - Ⓓ Ingredients are added in exact proportions.
3. Which detail describes the relationship between black powder and a firework?
   - Ⓐ Not all fireworks need black powder.
   - Ⓑ Adding more black powder will propel the firework higher.
   - Ⓒ Changing the amount of black powder will detonate the firework at the right time.
   - Ⓓ Black powder creates loud explosions.
4. Which of the following can describe main ideas of texts?
   - Ⓐ Some texts have more than one main idea.
   - Ⓑ All texts have more than one main idea.
   - Ⓒ No texts have more than one main idea.
   - Ⓓ When there is more than one main idea, supporting details are not needed.
5. What is the main idea of the "La Ronde" section?
   - Ⓐ Amusement parks are fun.
   - Ⓑ The Fireworks Festival is held inside La Ronde.
   - Ⓒ One of the rides at La Ronde is a miniature train.
   - Ⓓ La Ronde is the second-large[st] amusement park in Canada.
6. Stella wants to ________ her fat[her's] love for fireworks.
   - Ⓐ detonate
   - Ⓑ reignite
   - Ⓒ promote
   - Ⓓ evolve

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Name: Date:

Fun and Games: Fireworks: Multiplication Mathematics Quiz

Directions: Solve each problem to show what you know.

1. 139×7
   - Ⓐ 863
   - Ⓑ 773
   - Ⓒ 973
2. Which is the best estimate for 45×13?
   - Ⓐ 400
   - Ⓑ 600
   - Ⓒ 1,000
3. Lyle calculated 42×28. Identify his mistake. What is the correct solution?

$$\begin{array}{r} 42 \\ \times\ 28 \\ \hline 326 \\ +\ 840 \\ \hline 1,166 \end{array}$$

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How to Use This Product *(cont.)*

Pacing and Instructional Setting Options

The following pacing and instructional setting options show suggestions for how to use this product. *Mathematics Readers* is flexibly designed and can be used in tandem with a core curriculum within a mathematics block, literacy block, or both. Teachers should customize pacing according to student need (instruction may need to be extended over more days) and the teacher's preferred instructional frameworks, such as Guided Math or Guided Reading. This suggestion reflects one lesson per book for each of the 20 books. Each lesson spans 5 instructional days and requires 30–45 minutes, for a total of approximately 65 hours over the course of 100 days.

Day	**1**	**2**	**3**	**4**	**5**
Activity	Before Reading and Mathematics Investigation	During Reading	During Reading *(cont.)*	After Reading	Problem Solving and Assessments
Instructional Time	45 minutes	30 minutes	30 minutes	45 minutes	45 minutes

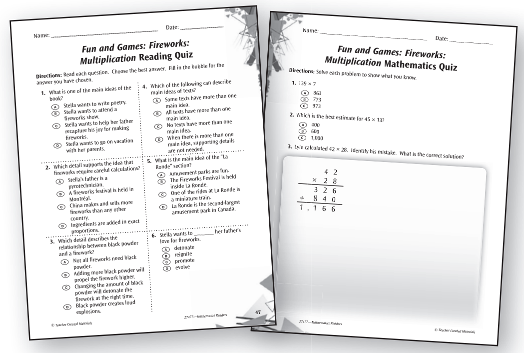
***Mathematics Readers* within the Guided Math and Balanced Literacy Frameworks**
Classroom Environment of Numeracy and Literacy—The books in *Mathematics Readers* contribute to an environment of numeracy and literacy by immersing students in real-world connections to mathematics and by giving students the opportunity to learn outside of content-area silos.
Whole-Class Instruction—The Before Reading activity in each *Mathematics Readers* lesson is a great opportunity to activate students' prior knowledge and capture their interest in a topic.
Small-Group Instruction—The lessons in *Mathematics Readers* offer flexibility that allows students to complete Before Reading, Mathematics Investigation, During Reading, and After Reading activities in small groups or any other preferred instructional setting, depending on student need. These activities have differentiation suggestions and targeted objectives and give students time to work with manipulatives and models.
Workshop—The During Reading, After Reading, and Problem Solving activities in each *Mathematics Readers* lesson can be completed during Math or Reading Workshop, in centers or at workstations, depending on students' previous learning experiences and their need for teacher support.
Conferencing—The Problem Solving activity and assessments in each *Mathematics Readers* lesson offer multiple opportunities for teachers and students to confer about concepts and ideas.
Assessment—*Mathematics Readers* offers multiple formative and summative assessment opportunities. Teachers can gain insight into student learning through reading and mathematics quizzes, small-group observations, analysis of written assignments, and a culminating activity.

How to Use This Product *(cont.)*

Assessment

Mathematics Readers offers multiple assessment opportunities. You can gain insight into student learning through reading and mathematics quizzes, small-group observations, analysis of written assignments, and a culminating activity. These formal and informal assessments provide you with the data needed to make informed decisions about what to teach and how to teach it. This is the best way for you to know who is struggling with various concepts and how to address difficulties that students are experiencing with the curriculum.

Mathematics and Reading quizzes—At the end of each lesson in this Teacher's Guide are two quizzes—one to assess the reading objective and one to assess the mathematics objective. These short assessments include text-dependent questions and may be used as open-book evaluations.



Name: Date:

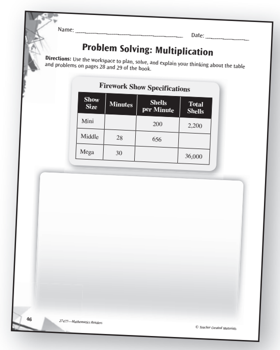
Fun and Games: Fireworks:
Multiplication Reading Quiz

Name: Date:

Fun and Games: Fireworks:
Multiplication Mathematics Quiz

Mathematics and Reading Quizzes

Problem Solving activity—Each lesson includes a multistep problem solving activity that can be used to assess understanding of the mathematical concepts or skills.



Name: Date:

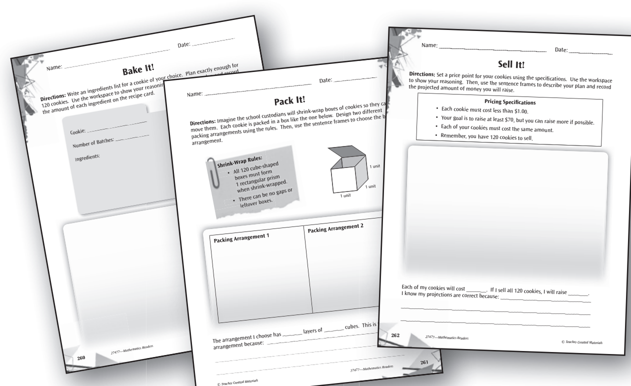
Problem Solving: Multiplication

Firework Show Specifications

Show Size	Minutes	Shells per Minute	Total Shells
Mini		200	2,200
Middle	28	656	
Mega	30		36,000

Problem Solving Activity

Culminating activity—The culminating activity asks students to apply what they have learned throughout the units in an engaging and interactive way. Students use what they have learned to create new ideas in a real-life context.



Bake It!

Pack It!

Packing Arrangement 1

Packing Arrangement 2

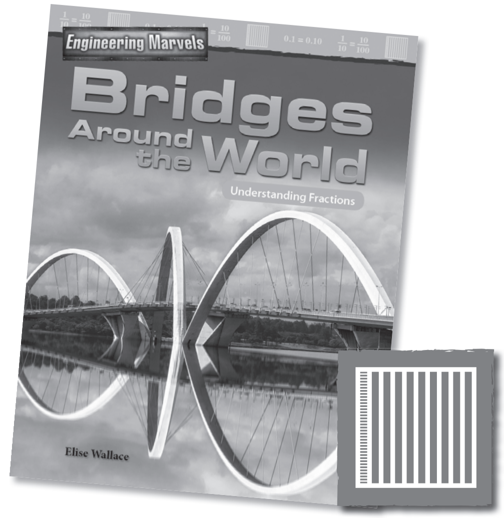
Sell It!

Pricing Specifications

Culminating Activity

Progress monitoring—There are several points throughout each lesson when useful evaluations can be made. These evaluations can be made based on group, paired, and individual discussions and activities.

Engineering Marvels: Bridges Around the World: Understanding Fractions



Materials

- *Engineering Marvels: Bridges Around the World: Understanding Fractions* books
- copies of student activity sheets (pages 109–114)
- *Square* (square.pdf)
- *Number Lines* (numberlines.pdf)

Learning Objectives

- Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade-appropriate topic or subject area.
- Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
- Use models and understanding of equal sharing to interpret fractions as division and solve word problems.

Mathematical Practices and Processes

- Reason abstractly and quantitatively.
- Model with mathematics.
- Attend to precision.

Lesson Timeline

<table>
<tr><th>Day 1</th><th>Day 2</th><th>Day 3</th><th>Day 4</th><th>Day 5</th></tr>
<tr><td>Before Reading and Mathematics Investigation
(pages 105–106)</td><td>During Reading
(page 107)</td><td>During Reading
(cont.)
(page 107)</td><td>After Reading
(page 107)</td><td>Problem Solving and Assessments
(page 108)</td></tr>
<tr><td>45 minutes</td><td>30 minutes</td><td>30 minutes</td><td>45 minutes</td><td>45 minutes</td></tr>
<tr><td>Identify unknown or unusual words in the text. Use models to represent equal shares and interpret fractions as division problems.</td><td colspan="2">Use strategies to determine the meanings of unknown words, and respond to the “Let’s Explore Math” sidebars.</td><td>Write a fictional narrative about a walk across a bridge.</td><td>Review the vocabulary, complete the problem solving activity, and take the assessments.</td></tr>
</table>

Engineering Marvels: Bridges Around the World: Understanding Fractions *(cont.)*

Mathematics Vocabulary

- division
- fraction
- equal shares

Before Reading

1. Distribute the *Engineering Marvels: Bridges Around the World: Understanding Fractions* books to students. Read the title and back cover. Have students use the back cover to find one word they have heard before but don't know well, and one word they have never heard before. Demonstrate how to use context clues on the back cover to determine the meaning of words and clarify as necessary.
2. As a group, read the first paragraph of page 4. Point out the sentence, "Bridges help people cross over water that would be otherwise inaccessible." Have students meet in pairs to discuss the meaning of *inaccessible* and the clues used to form the meaning. Tell students that they will use context clues, such as examples, in-text definitions, synonyms, and antonyms to determine word meanings in the text.
3. Have students preview the "Let's Explore Math" sidebars, finding examples of math words. Have students predict the mathematics in the book based on the math words identified.

Mathematics Investigation

Build Understanding

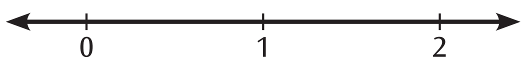
1. Have students read the introductory text of the sidebar on page 14 of *Engineering Marvels: Bridges Around the World: Understanding Fractions*. Have students imagine that three friends are equally sharing one waffle. Read the vocabulary words aloud. Guide students to create student-friendly definitions.
    - *What information is known? What information is missing?*
    - *Will each friend get more or less than one waffle? How do you know?*
    - *Which operation can help you find equal shares?*
2. Distribute paper squares to students. You may wish to use *Square* (square.pdf) from the Digital Resources. Tell students that the square represents a waffle. Ask students how they can fold the square to show how much of the waffle each friend receives.
    - Have **above-level learners** use squares to find the share of the waffle that six and nine friends would get, and explain patterns in their solutions.
    - Confirm that **below-level learners** and **English language learners** understand that one waffle is being shared by three friends, so they are finding the share of the waffle each friend gets.
3. Ask students guiding questions to build understanding.
    - *How are you checking to be sure each share is equal?*
    - *How can you use fractions to represent the share of the waffle each friend receives?*
    - *How many ways are there to fold the square? Does the share change? Why or why not?*
    - *How can division help you solve the problem?*
    - *How can you write an equation to show your thinking?*

Engineering Marvels: Bridges Around the World: Understanding Fractions *(cont.)*

Mathematics Investigation *(cont.)*

Expand Understanding

1. Ask students to describe how folding squares shows equal shares. Explain to students that number lines can also show equal shares. Distribute *Number Lines* (numberlines.pdf) from the Digital Resources to students. Guide students to draw a number line like the one below.



2. Have students imagine that three friends are equally sharing two waffles. Ask students to use the number lines to show how much of the waffles each friend gets.

3. Ask students guiding questions to expand understanding.
   - *Why does the number line show two wholes?*
   - *Will each friend get more or less than one waffle? How do you know?*
   - *How can you use fractions to describe how much of the waffles each friend gets?*
   - *How are you showing equal shares on the number line?*
   - *How can you label the number line to show your thinking?*
   - *How can you write a division equation to show your thinking?*

Apply Understanding

1. Distribute *Fair Share Waffles* (page 109).

2. Ask students questions to assess understanding.
   - *What information is known? What are you trying to find?*
   - *How do your pictures show equal shares?*
   - *How are you checking to make sure that your answers are reasonable?*
   - *How can you tell whether each friend will get more or less than one waffle?*
   - *Does the order of the numbers matter in the equation? Why?*
   - *How are fractions and division related?*

Engineering Marvels: Bridges Around the World: Understanding Fractions *(cont.)*

During Reading

1. Distribute the *Engineering Marvels: Bridges Around the World: Understanding Fractions* books to students. As a group, read pages 4–6 aloud. Model using context clues to determine the meaning of unknown words and phrases. For example, after reading page 6, point out the word *mainland*. Have students find the antonym (*island*) included by the author to explain the phrase's meaning.
    - You may choose to display the Interactiv-eBook for a more digitally enhanced reading experience.
    - For **below-level learners** and **English language learners**, you may choose to play the audio recording as students follow along to serve as a model of fluent reading. This may be done in small groups or at a listening station to help struggling readers practice fluency and build comprehension.
2. Distribute *Bridge to Meaning* (page 110) to students. Discuss different types of context clues, such as synonyms, antonyms, in-text definitions, and examples. Discuss other strategies, such as referencing glossaries and text features. Have students complete the activity sheet by using context clues from the text to define the words. Discuss students' strategies as a class.
3. Have students complete the "Let's Explore Math" sidebars as they read the book. Or, you may choose to have them revisit the text a second time to complete the sidebars. Review student responses as a class.

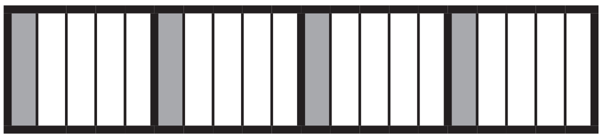
After Reading

1. Distribute the *Engineering Marvels: Bridges Around the World: Understanding Fractions* books to students. Have students find examples of how the author's use of context clues helped readers determine the meanings of unusual words and phrases.
2. Explain to students that they will write stories about imagined walks across one of the bridges in the book, using context clues to help the reader determine the meaning of a mathematical term.
3. Distribute *Let's Take a Walk* (page 111) to students. Have them use their activity sheets to plan their narratives. Then, have students write their narratives on separate sheets of paper. Have students share their narratives in small groups.
    - Challenge **above-level learners** to use at least two of the words they identified on their *Bridge to Meaning* activity sheets from the During Reading activity in their stories.

Engineering Marvels: Bridges Around the World: Understanding Fractions (cont.)

Problem Solving

1. Display the following model for students:



2. Have students write division equations that represent the model and describe them with the terms *division*, *equal shares*, and *fraction*.
   - Support **below-level learners** and **English language learners** with sentence frames.
     - *The model shows* ________.
     - ________ *divided by* ________ *is* ________.
     - *I know my equation is correct because* ________.
3. Read the Problem Solving prompt aloud from page 28 of the *Engineering Marvels: Bridges Around the World: Understanding Fractions* book. Distribute *Problem Solving: Understanding Fractions* (page 112) to students. Have students use the workspace to solve the problem.

Assessments

1. A short posttest, *Engineering Marvels: Bridges Around the World: Understanding Fractions Reading Quiz* (page 113), is provided to assess this lesson's reading objective.
2. A short posttest, *Engineering Marvels: Bridges Around the World: Understanding Fractions Mathematics Quiz* (page 114), is provided to assess this lesson's mathematics objective.
3. The Interactiv-eBook activities in the Digital Resources may also be used for assessment purposes (optional).

Name: ______________________________ Date: ______________

Fair Share Waffles

Directions: Draw pictures to show how the friends can equally share the waffles. Then, write division equations to represent the situations.

1. 6 friends share 1 waffle.

Equation: ______________________________

2. 6 friends share 3 waffles.

Equation: ______________________________

3. 6 friends share 5 waffles.

Equation: ______________________________

Name: ______________________________ Date: ______________

Bridge to Meaning

Directions: Write five unusual words from the text. Make sure one of the words is a math word. Then, write the meanings of the words and the strategies you used to determine the meanings.

Word	Meaning	Strategy
1.		
2.		
3.		
4.		
5. Math word:		

Name: ______________________________ Date: ______________

Let's Take a Walk

Directions: Plan a narrative about walking across one of the bridges in the book. Then, write your story on a separate sheet of paper.

Characters	**Setting**

Problem

Sequence of Events

1.

2.

3.

Math Word with Context Clue

Solution

Name: ________________________________ Date: ______________

Problem Solving: Understanding Fractions

Directions: Use the workspace to plan, solve, and explain your thinking about the problems and bridge specifications on page 28 of the book.

Bridge Specifications

- Length: 1,200 meters
- Height: 60 meters
- Width: 36 meters
- Number of Lanes: 8

Name: ___________________________________ Date: ______________

Engineering Marvels: Bridges Around the World: Understanding Fractions Reading Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

1. How are aqueducts different from viaducts?

- Ⓐ Aqueducts and viaducts are two words for the same thing.
- Ⓑ Aqueducts carry water and viaducts go through water.
- Ⓒ Aqueducts are low bridges and viaducts are high bridges.
- Ⓓ Aqueducts carry water and viaducts carry roads or railroads.

2. What does *seismic* mean in the following sentence? *The new bridge can endure strong winds and seismic activity.*

- Ⓐ caused by winds
- Ⓑ caused by earthquakes
- Ⓒ caused by vehicles
- Ⓓ caused by storms

3. Which context clue helps readers determine the meaning of *durable* in the following sentence? *But, Morrow liked the color and found a durable paint.*

- Ⓐ "The bridge has a distinct red-orange hue."
- Ⓑ "The bright color makes the bridge visible even on the foggiest days."
- Ⓒ "No one thought red paint could withstand the salty air."
- Ⓓ "This span is suspended from two cables that join two tall towers."

4. Why do engineers and architects need blueprints?

- Ⓐ Blueprints are sketches used to start projects.
- Ⓑ Blueprints are plans showing how something will be built.
- Ⓒ Blueprints are only needed for bridges.
- Ⓓ Blueprints are diagrams showing where water is located.

5. What does it mean if a bridge is only for pedestrians?

- Ⓐ It is only meant for water.
- Ⓑ It is only meant for railroads.
- Ⓒ It is only meant for vehicles.
- Ⓓ It is only meant for people.

6. The Brooklyn Bridge is one of the ______ symbols of New York.

- Ⓐ inaccessible
- Ⓑ substantial
- Ⓒ tiered
- Ⓓ iconic

Name: ______________________________ Date: ______________

Engineering Marvels: Bridges Around the World: Understanding Fractions Mathematics Quiz

Directions: Solve each problem to show what you know.

1. If 4 friends equally share 5 brownies, how much of a brownie does each friend get?

(A) $\frac{4}{5}$ (B) $\frac{5}{4}$ (C) $\frac{1}{4}$

2. Which equation represents 6 people equally sharing 2 cakes?

(A) $1 \div 6 = \frac{1}{6}$
(B) $2 \div 6 = \frac{2}{6}$
(C) $6 \div 2 = 3$

3. If 3 people equally share 8 cookies, how much of a cookie does each person get? Draw a model and write a division equation to represent the situation.

Engineering Marvels

Bridges Around the World

Understanding Fractions

Elise Wallace

Consultants

Lisa Ellick, M.A.
Math Specialist
Norfolk Public Schools

Pamela Estrada, M.S.Ed.
Teacher
Westminster School District

Publishing Credits

Rachelle Cracchiolo, M.S.Ed., *Publisher*
Conni Medina, M.A.Ed., *Managing Editor*
Dona Herweck Rice, *Series Developer*
Emily R. Smith, M.A.Ed., *Series Developer*
Diana Kenney, M.A.Ed., NBCT, *Content Director*
Stacy Monsman, M.A., *Editor*
Kristy Stark, M.A.Ed., *Editor*
Kevin Panter, *Graphic Designer*

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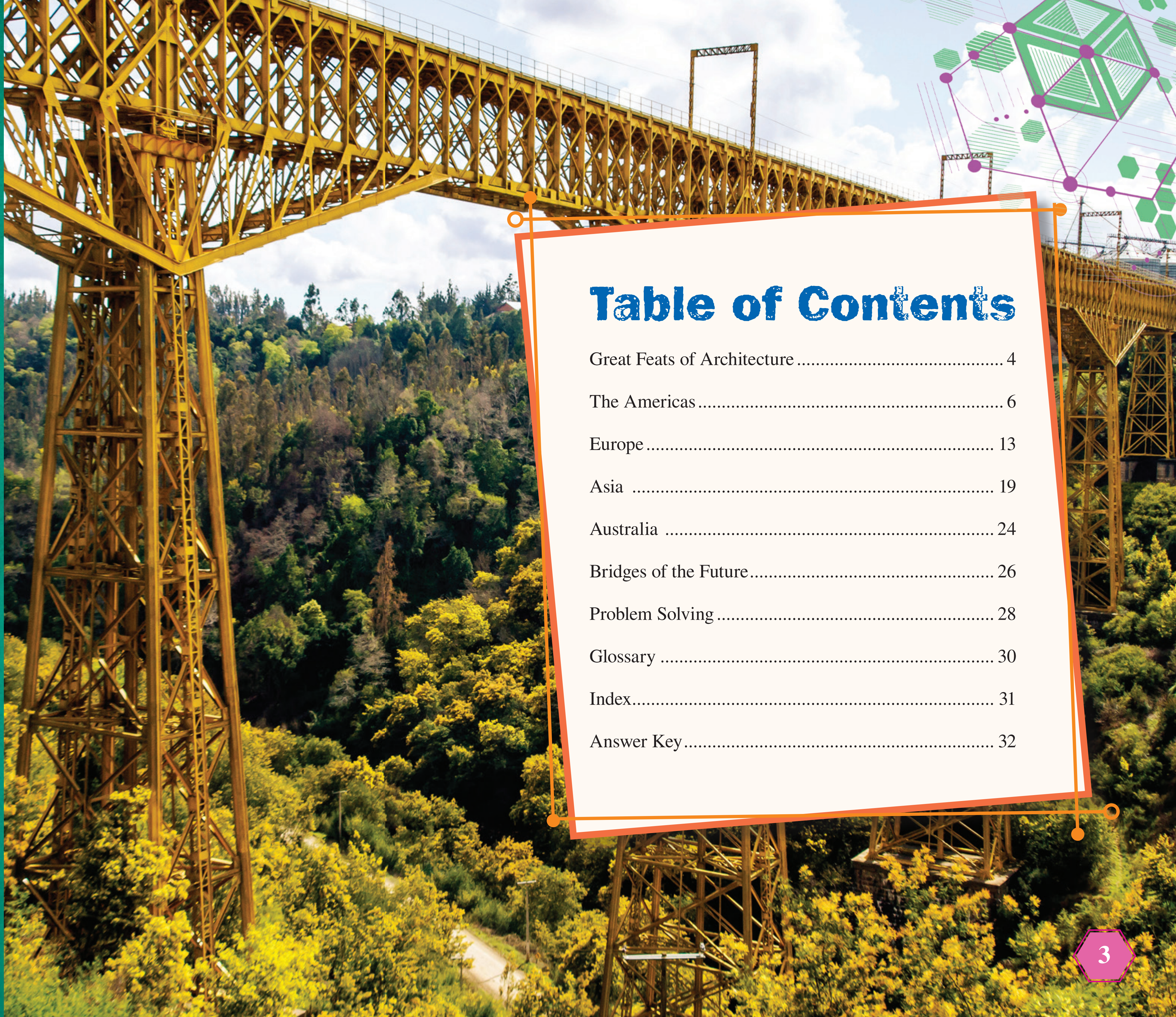


Table of Contents

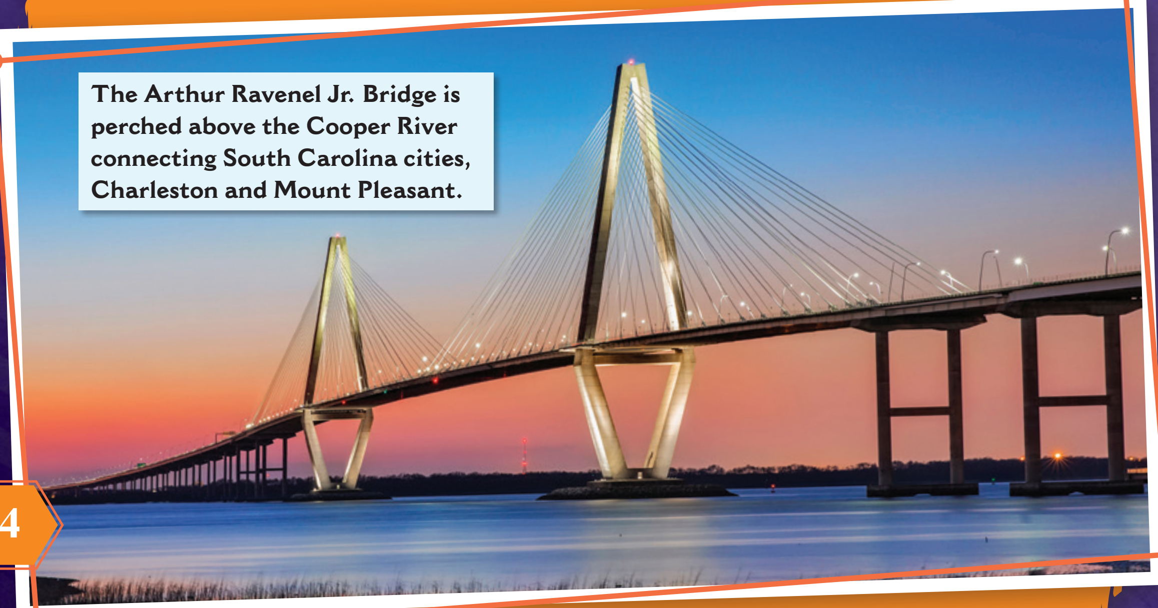
Great Feats of Architecture

Bridges help people cross great heights. They help people cross water that would otherwise be **inaccessible**. People use them to walk, bike, and drive to new places. Because of bridges, many of the world's wonders become available.

Some bridges are more than a link between two places. They are **feats** of architecture. When we see pictures, we are dazzled by their size. But, when we learn about each **engineering** feat, these bridges become even more awe-inspiring.

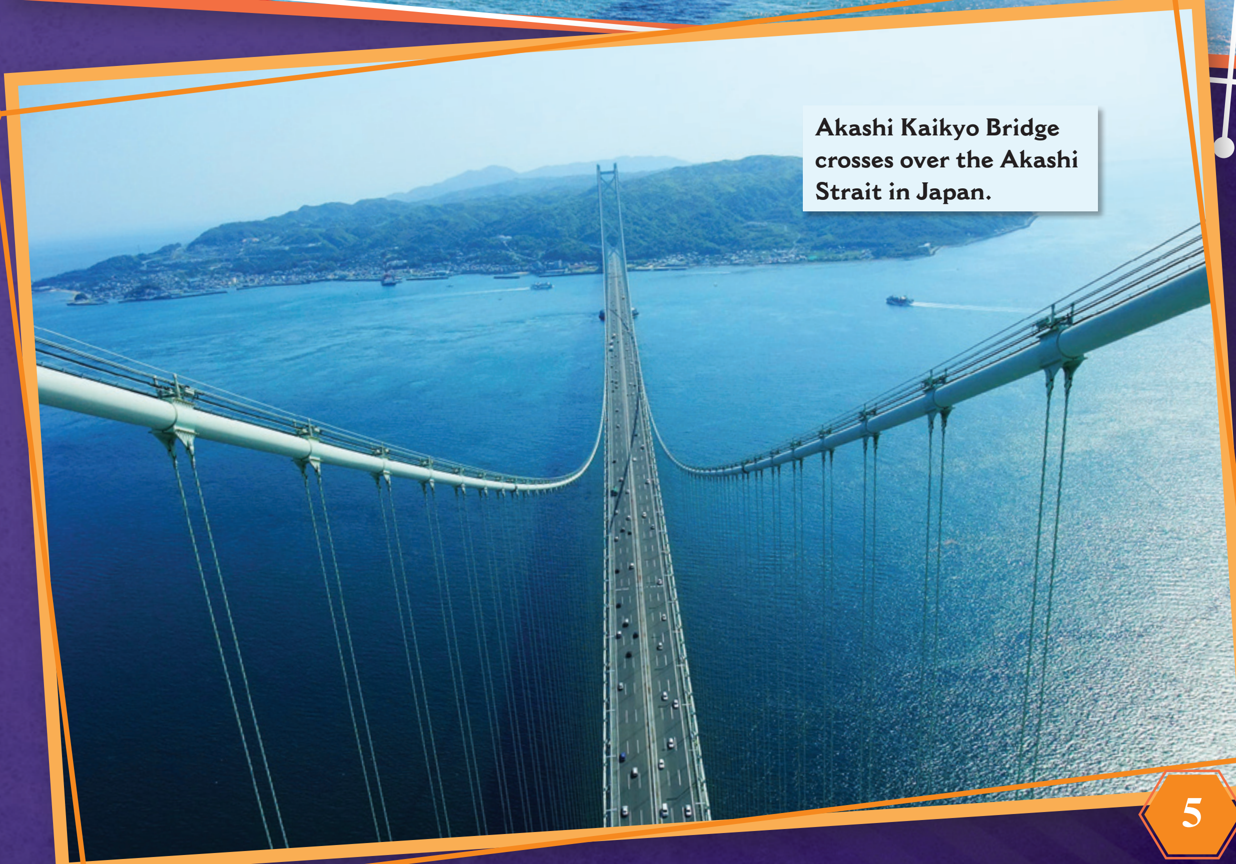
The stories of these bridges celebrate **engineers** and **architects**. They show the work of some of the best minds in the world. These people think outside-the-box to create original structures. In doing so, they have helped construct some of the most famous and revered bridges in the world.

But, architects and engineers do not work alone. Many skilled workers help bring their visions to life. From an idea, to a sketch, to a **blueprint**, to a construction site, each great bridge is the work of many minds and countless hours.



The Arthur Ravenel Jr. Bridge is perched above the Cooper River connecting South Carolina cities, Charleston and Mount Pleasant.

The Golden Gate Bridge connects the city of San Francisco to Marin County.



Akashi Kaikyo Bridge crosses over the Akashi Strait in Japan.

The Americas

There are many shining bridges in the Americas. Many of them have changed the future of architecture.

Confederation Bridge

The Confederation Bridge in Canada links Prince Edward Island to New Brunswick. In the past, people could only get to the island by ferryboats. In winter, ice was likely to stop the boats. Some people wanted a bridge. Other people wanted to keep the existing boat system. They did not want people from the **mainland** to have a year-round link to the island. The people voted to settle the issue. Fifty-nine percent of the people voted "yes" to the bridge.

In 1997, the 8-mile (13-kilometer) bridge was finished. It is the longest bridge in the world to span icy waters. Engineers designed the bridge with drivers' safety in mind. They made sure the bridge has curves. Drivers are more likely to stay focused if they need to drive on a curved road rather than a straight one. Engineers also made sure to include thousands of drain ports. These keep water and ice from sitting on the road. With Canada's rainy and snowy seasons, this is a required feature!

Confederation Bridge

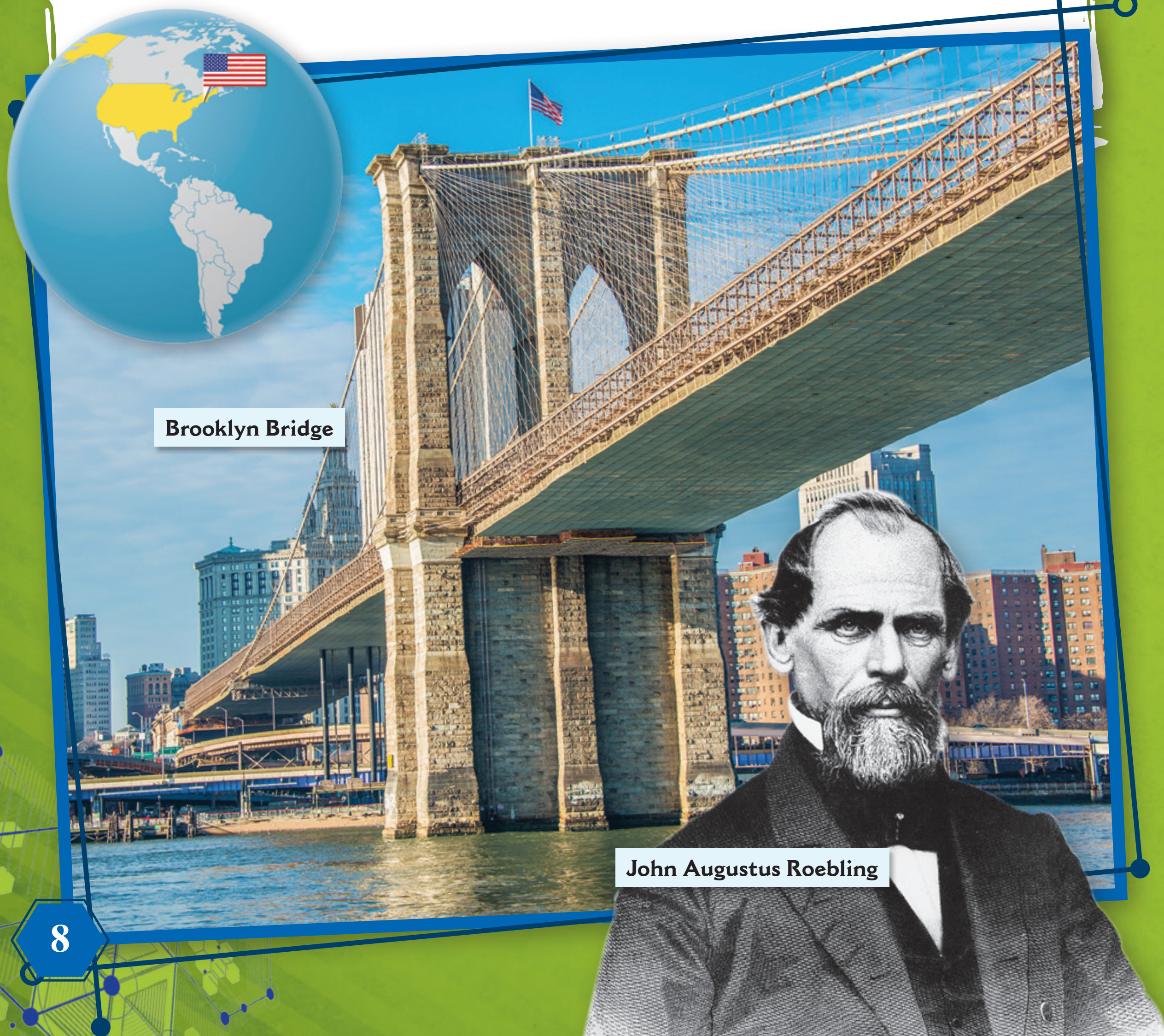
LET'S EXPLORE MATH

It takes about 10 minutes to drive across the 8-mile long Confederation Bridge. Imagine that a vehicle is being driven the same distance every minute. Is it being driven more or less than 1 mile each minute? Explain your reasoning.

Brooklyn Bridge

The Brooklyn Bridge is **iconic**. It spans the East River between Brooklyn and Manhattan in New York City. It was designed by John Augustus Roebling. This **suspension bridge** was the first to use steel cables.

Sadly, Roebling died before building began. His son took over the project. When it was completed in 1883, it was the longest bridge in the world. It has a total length of 5,989 feet (1,825 meters). Each day, thousands of people still cross the Brooklyn Bridge.



Brooklyn Bridge

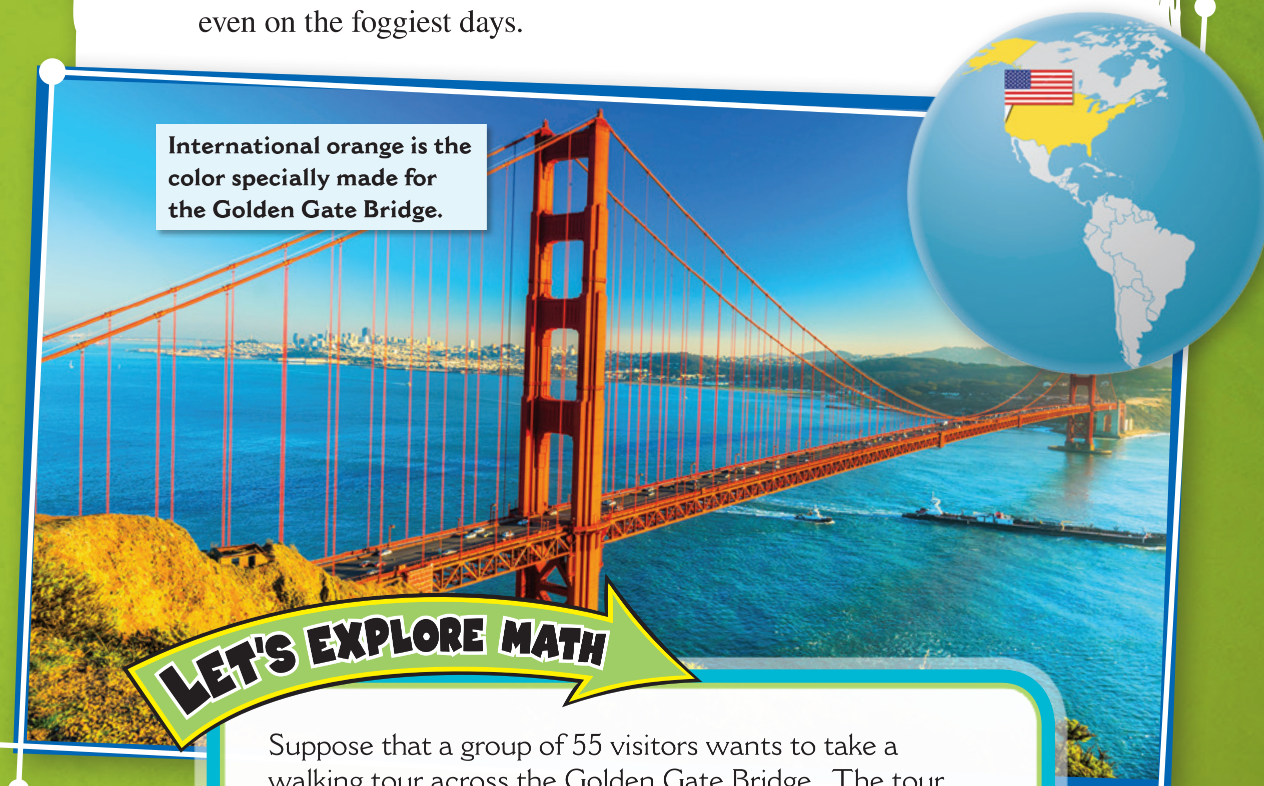
John Augustus Roebling

Golden Gate Bridge

The Golden Gate Bridge is a suspension bridge in San Francisco, California. Joseph B. Strauss oversaw its construction. He was an engineer. He hired Irving Morrow to help design the bridge. It was finished in 1937.

The main span of the bridge is 4,200 ft. (1,280 m) long. This span is suspended from two cables that join two tall towers. The towers are 746 ft. (227 m) tall.

The bridge has a distinct red-orange hue. No one thought red paint could withstand the salty air. But, Morrow liked the color and found a **durable** paint. The bright color makes the bridge visible even on the foggiest days.



International orange is the color specially made for the Golden Gate Bridge.

LET'S EXPLORE MATH

Suppose that a group of 55 visitors wants to take a walking tour across the Golden Gate Bridge. The tour guides can only have a maximum of 12 people in each group. How many tour guides are needed to take all of the visitors on walking tours? Explain your reasoning.

Malleco Viaduct

Sometimes bridges must cross land instead of water. The Malleco Viaduct is one of Chile's great structures. It has an intriguing history. Built in the late 1800s, the bridge was part of the country's plan to extend its railways.

There was just one problem with the plan: the depth of the Malleco River Valley. The river is 361 ft. (110 m) below the land! To build a railroad, engineers would need to find a way around or over the valley. The choice was clear but not simple. A **viaduct**, or railroad bridge, would have to be constructed. This bridge would cross the valley.

To create this structure, the bridge would need **substantial** support. There are four piers, or pillars, at the center of the bridge. Each pier helps support the weight of the bridge. At each end of the bridge, two stirrups also help bear the weight of the structure. All of the supporting structures are made of steel.

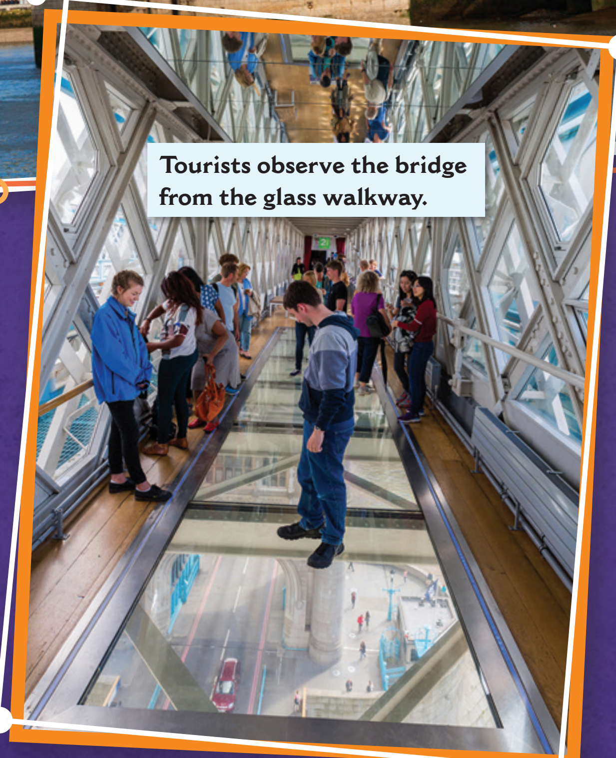
The bridge was completed in 1890. At that time, it was the highest railroad bridge in the world at 333 ft. (101 m). It spans 1,419 ft. (432.5 m) across the valley below.

LET'S EXPLORE MATH

The Malleco Viaduct has 5 equal sections. Imagine that 3 crews are performing maintenance. Use the model to show how they could equally share the work. How much of a section does each crew maintain?

Tower Bridge

The drawbridge opens for a ship.



Tourists observe the bridge from the glass walkway.

Europe

Lots of structures and buildings in Europe are several centuries old. This is true about Europe's bridges, too. They were built many years ago by ambitious engineers. Each is beautiful and is a tribute to the great minds of the past.

Tower Bridge

The River Thames (TEMZ) is one of the longest rivers in England. Tower Bridge spans the Thames. It has been a distinct feature in London for more than 120 years. It was finished in 1894. Tower Bridge features a double-leaf bascule, or drawbridge. It opens 250 ft. (76 m) to let large ships pass through. Long ago, the bridge was powered by steam. In the last few decades, the drawbridge has been powered by motors.

Today, people can learn more about the bridge by visiting its museum. There, people can stand on a glass walkway above the drawbridge. They see the drawbridge open and close beneath them. The bridge's old steam engines can be viewed in the museum, too. Visitors can get close to view items from the bridge's history!

Pont du Gard

Pont du Gard is a bridge that is a work of art. And, it is over 3,000 years old! The bridge resides in southern France. But, it was constructed by the Romans. Long ago, France was part of the Roman Empire. The Romans were great engineers and built many structures.

Roman buildings often include **arches**. Arches provide strong structural support. The Pont du Gard has three tiers of arches that cross the River Gard. It was constructed as an **aqueduct** to transport fresh water.

Ponte Vecchio

Ponte Vecchio is in Florence, Italy. The name means "old bridge." It was engineered by Taddeo Gaddi and was built in 1345. Gaddi was also a famous artist. Today, the bridge is a well-known landmark.

Arches support this bridge, too. But, these arches are not like the Roman arches. The Roman arches are full semi-circles. The arches on the Ponte Vecchio are not full semicircles. They are called segmental arches. This type of arch was invented in the later part of the Middle Ages, after the fall of the Roman Empire. The arches give the bridge's waterway a spacious feel. This allows boats to easily travel under the bridge.

LET'S EXPLORE MATH

Today, the Pont du Gard is a popular place for tourists to visit. A restaurant at the site even features fresh waffles.

1. Imagine that 6 tourists want to share 4 waffles. Draw a picture showing how they can equally share the waffles.
2. How much of a waffle does each tourist get?
3. How is your answer related to the division problem $4 \div 6$?

Pont du Gard

Ponte Vecchio's segmental arches

Taddeo Gaddi

The Chain Bridge

The Chain Bridge crosses the Danube River in Budapest, Hungary. This suspension bridge is 1,230 ft. (375 m) long. Its official name is Szechenyi (SAY-chay-nee) Chain Bridge. The bridge is a grand structure. It is made mainly of iron with chain links. Each link is huge, movable, and connected by giant rivets.

But, the Chain Bridge is special for more than its iron links. Over 140 years ago, it linked two cities: Buda and Pest. These cities were on opposite sides of the Danube River. It took the Chain Bridge to help form one city.

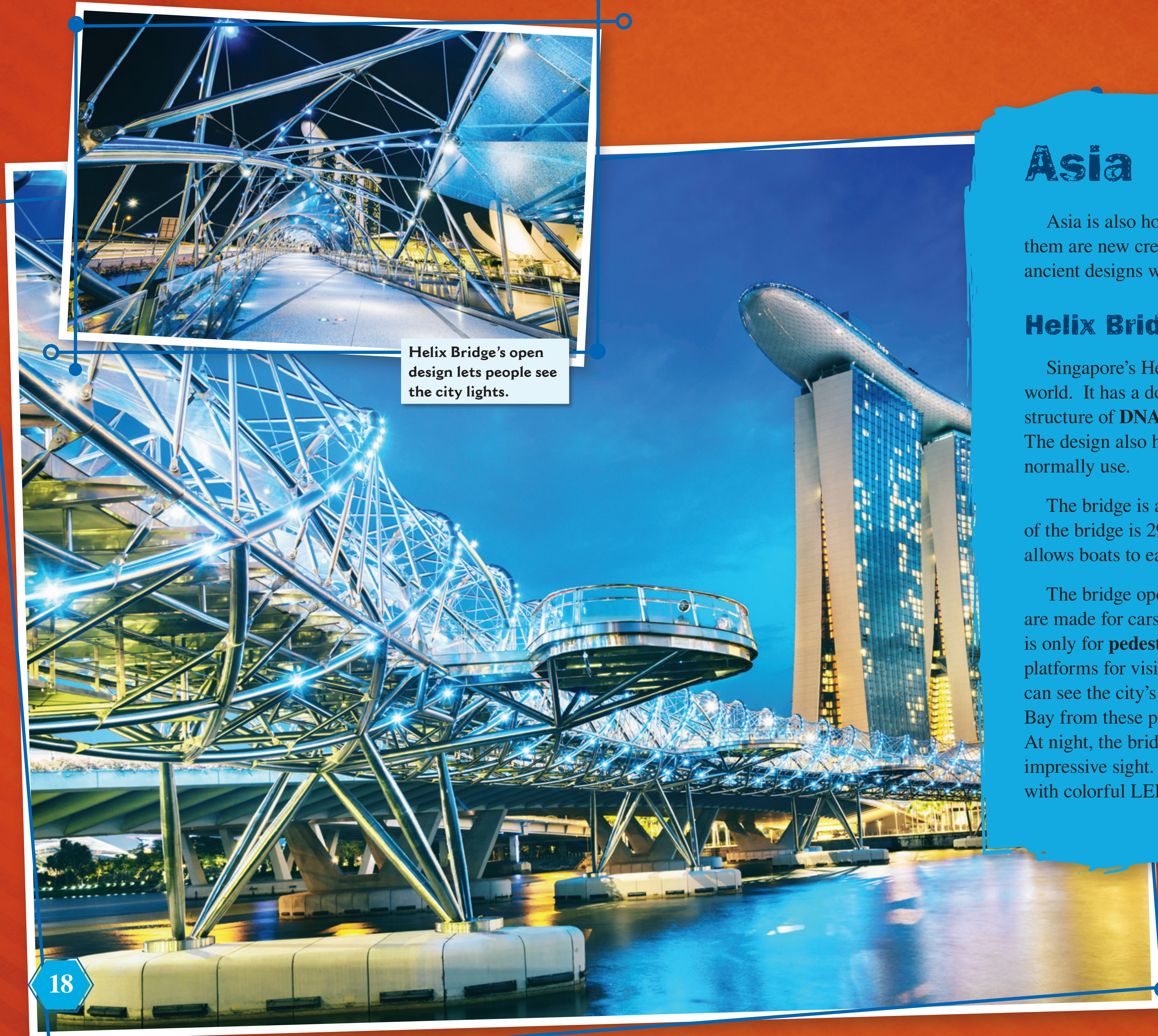
Scottish engineer Adam Clark supervised the bridge's construction. Work began in 1840. It was completed in 1849.

Finally, in 1873, Buda and Pest officially merged to become Budapest. The Chain Bridge did more than connect two cities. It linked two ways of life. Even today, Buda and Pest have very different personalities. Buda is the land of old traditions. It is home to the grand Buda Castle. Pest is a lively area known for its entertainment and many restaurants. To honor Clark and his work, there is a park on one end of the bridge, called Adam Clark Square.

LET'S EXPLORE MATH

The Chain Bridge is about 15 meters wide. It is divided into 2 lanes. How wide is each lane? Represent your answer using meters.

the Chain Bridge



Helix Bridge's open design lets people see the city lights.

Asia

Asia is also home to many amazing bridges. Some of them are new creations that look futuristic. Others are ancient designs with long histories.

Helix Bridge

Singapore's Helix Bridge is unlike any bridge in the world. It has a double helix design that resembles the structure of **DNA**. It gives the bridge a unique look. The design also helped builders use less steel than they normally use.

The bridge is about 919 ft. (280 m) long. The bottom of the bridge is 29 ft. (9 m) above the water. This height allows boats to easily pass.

The bridge opened on April 24, 2010. Many bridges are made for cars, trucks, and buses. But, Helix Bridge is only for **pedestrians**. The bridge has five large platforms for visitors to stop to look at the views. People can see the city's skyline and Marina Bay from these platforms. At night, the bridge is an impressive sight. It sparkles with colorful LED lights.

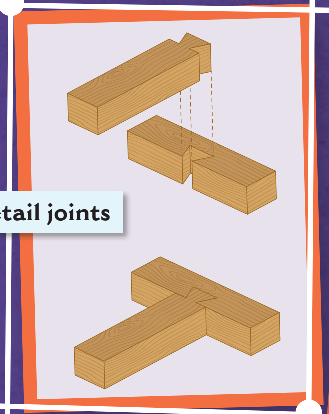
Chengyang Bridge

Chinese builders have constructed bridges for thousands of years. However, Chengyang Bridge was built about a hundred years ago in 1916. Yes, that may sound like a long time ago. But, it is not that long when you consider that many Chinese structures date back 6,000 years!

The bridge is a wind and rain bridge because it has a canopy that protects visitors from wind, rain, and other weather. Many bridges in China are built this same way.

Like Helix Bridge, Chengyang Bridge is only meant for people, not vehicles. It is about 210 ft. (64 m) in length. And, it is 33 ft. (10 m) in height. It is only about 11 ft. (3 m) wide. Even so, the bridge is impressive for reasons other than its size.

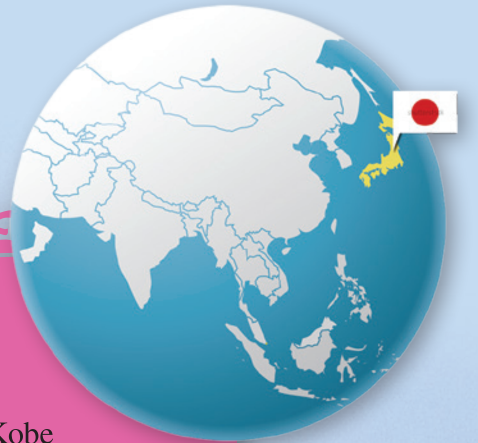
The bridge has five pagodas, or tiered towers. There are porches and benches for people to relax and enjoy the views. The structure is mainly made of wood, but no rivets or nails were used to secure the pieces. Instead, pieces are interlocked into **dovetail** joints. These joints make the bridge sturdy.



LET'S EXPLORE MATH

Imagine that 4 visitors want to equally share 11 feet of walking space as they cross Chengyang Bridge.

1. How many feet of walking space will each visitor get?
2. Draw a picture to prove your solution.
3. Write a division equation to represent the situation.



Pearl Bridge

A huge earthquake shook Japan on January 17, 1995. It destroyed Kobe (KO-bay), one of Japan's busiest cities. Each second of the earthquake caused more and more chaos. Cars were thrown. Buildings toppled. Highways collapsed.

Pearl Bridge, also known as Akashi (UH-ka-she) Strait Bridge, was affected, too. It was under construction at the time of the earthquake. The earthquake caused terrible damage to the city. And, it forced engineers to rethink the bridge's design. The bridge had two towers that supported the structure. The earthquake pushed apart those towers. The engineers knew that they would need to make the bridge stronger.

Pearl Bridge took 10 years to rebuild. At the time of its completion in 1998, it became the longest suspension bridge in the world. It is 12,831 ft. (3,911 m) long. Its two towers are 928 ft. (283 m) tall.

The bridge can endure winds up to 180 miles (290 kilometers) an hour and severe pressure from storms and **seismic** activity. In strong winds or storms, the bridge may expand or contract several feet in a day.

Pearl Bridge lays in ruin after the 1995 earthquake.

Australia

Locals call it the "coat hanger" bridge. It is officially called the Sydney Harbour Bridge. It is one of the world's longest steel arch bridges. It spans 1,650 ft. (503 m).

The bridge was built by the Sydney Opera House. Today, both are iconic pieces of the city's skyline. But back in 1912, the idea to build a suspension bridge across Sydney Harbour was just that—an idea. John Bradfield, an engineer, submitted a **cantilever**, or long beam, design for the bridge. It was accepted. But, the project was put on hold when World War I started.

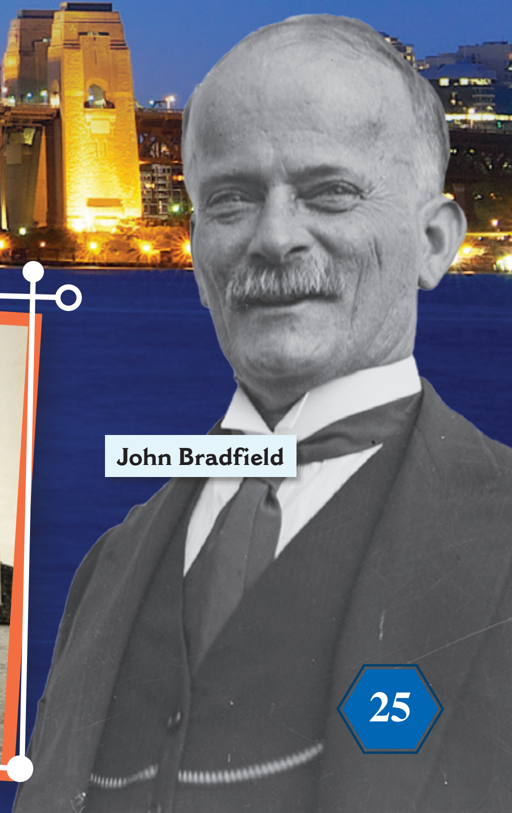
Once the war ended, steel was available to make the bridge. The architects wanted the bridge to support a lot of weight. They chose a sturdy design that featured steel arches. They used this design instead of Bradfield's. However, he was chosen to oversee the bridge's construction. It was finished in 1932.

The bridge was built without **scaffolding**, or temporary supports. These supports could not be used because the harbor was too deep! Instead, each side of the bridge was built at the same time. Workers constructed the bridge on each side of the bay. They met in the middle and connected the two sides.

Sydney Opera House

Sydney Harbour Bridge

Sydney Harbour Bridge under construction



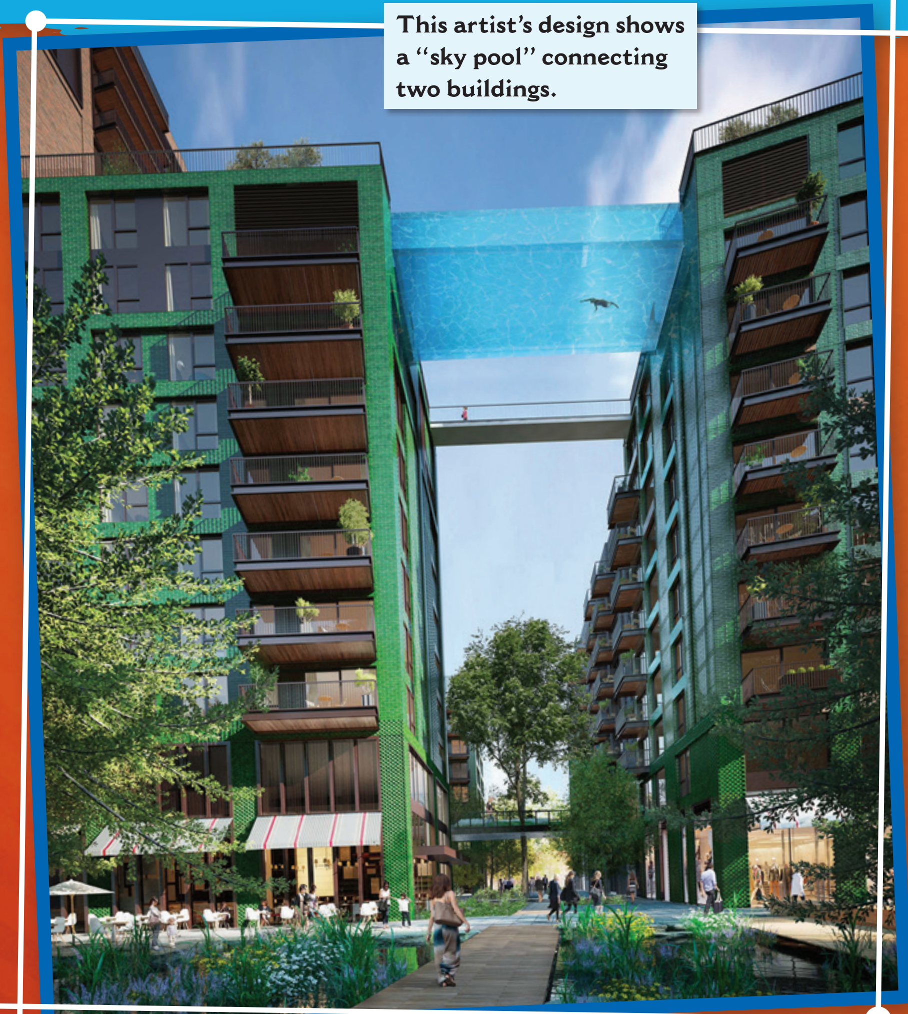
John Bradfield

Bridges of the Future

All over the world, engineers plan for the future. They design new bridges and buildings. Many designs are unlike any that have been seen before.

In London, England, architects have proposed a water bridge. This "sky pool" will connect two apartment buildings. People will be able to swim across the bridge. It is expected to be finished in 2018.

Plans have been made for a unique bridge in Taiwan. It will be called the Danjiang (DAN-gee-ang) Bridge. Its engineers hope to break records. The bridge will be 3,000 ft. (914 m) long and will be supported by only a single tower.



This artist's design shows a "sky pool" connecting two buildings.

Danjiang Bridge

There are many other bridges being designed. Like those that came before, they will connect communities. Each bridge will be designed to inspire people, too.

Of course, each design may present challenges and problems. But, today's engineers will work to solve those problems. They will address any challenges they face, so they can complete each new bridge. In doing so, they will add new wonders to skylines. They will give people new places to visit, too.

Problem Solving

Congratulations! Your engineering firm has been hired to design a highway bridge over a large valley. City council wants to understand the details about the bridge being planned for the community. So, it submits a list of questions for you to answer. Use the bridge specifications to answer them.

Bridge Specifications

- Length: 1,200 meters
- Height: 60 meters
- Width: 36 meters
- Number of Lanes: 8

1. How wide is each lane?
2. You are planning to include five toll booths. How many lanes will each toll booth serve?
3. You are planning to install a concrete pillar every 90 meters to support the length of the bridge. How many bridge supports will there be?
4. The metal beams inside each vertical bridge support are 28 meters long. How many beams will be inside each support?
5. This bridge is going to be busy. The transportation department estimates that there will be about 6,200 vehicles on the bridge each hour. About how many vehicles is this per minute?

Glossary

aqueduct—a structure used to carry water

arches—parts of curves

architects—people who design buildings

blueprint—a plan that shows how something will be built

cantilever—a piece of wood or metal that sticks out from a structure to support the weight above

DNA—deoxyribonucleic acid; material in a cell's nucleus

dovetail—a joint used to connect two pieces of wood

durable—the ability to stay strong and in good condition for a long time

engineering—designing and creating products, systems, or structures by using tools, materials, mathematics, and science

engineers—people who use mathematics and science to solve problems

feats—acts to show great skill and courage

iconic—well-known

inaccessible—difficult or impossible to be reached

mainland—a large area of land that does not include islands

pedestrians—people who travel on foot

scaffolding—metal poles and wooden boards used to build or support

seismic—caused by an earthquake

substantial—large amount

suspension bridge—a bridge hung from two or more cables that are held up by towers

viaduct—a long, high bridge that carries a road or railroad over something

Index

Answer Key

Let's Explore Math

page 7:

Less than 1 mile per minute; Explanations will vary, but may include that if the vehicle is driven 1 mile for each of 10 minutes, 10 miles will be traveled. Only 8 miles are traveled. So, the vehicle must be moving less than 1 mile each minute.

page 9:

5 tour guides; Explanations will vary, but may include that 12 visitors × 4 tour guides is 48 visitors, so another tour guide is needed for the 7 remaining visitors.

page 10:

$\frac{5}{3}$, or $1\frac{2}{3}$ sections; Models will vary. Example:

1	2	3	1	2	3	1	2	3

page 14:

1. Models will vary. Example:

1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6

2. $\frac{4}{6}$ of a waffle
3. It is related because 4 waffles are being divided among 6 tourists and $4 \div 6$ is $\frac{4}{6}$.

page 17:

$7\frac{1}{2}$ m

page 21:

1. $2\frac{3}{4}$ ft., or $\frac{11}{4}$ ft.
2. Pictures will vary. Example:

1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

3. $11 \div 4 = \frac{11}{4}$ or $2\frac{3}{4}$

Problem Solving

1. $\frac{36}{8} = 4\frac{4}{8}$ m, or $4\frac{1}{2}$ m
2. $\frac{8}{5} = 1\frac{3}{5}$ lanes
3. $\frac{1{,}200}{90} = 13\frac{30}{90}$, or $13\frac{1}{3}$; 14 bridge supports
4. $\frac{60}{28} = 2\frac{4}{28}$, or $2\frac{1}{7}$ beams
5. $\frac{6{,}200}{60} = 103\frac{20}{60}$, or $103\frac{1}{3}$; 103 or 104 vehicles per minute

Math Talk

1. How are fractions examples of division problems?
2. How can fractions show remainders?
3. How are these situations similar and different?
   a. If 15 students share 5 pizzas equally, what part of a whole pizza will each student get?
   b. If 5 students share 15 pizzas, what part of a whole pizza will each student get?
4. How can you use an area model to show 3 workers sharing 8 sandwiches equally?
5. There are 2 bagels and 4 students. Tisha says, "There is no way to equally share the bagels because I cannot divide 2 by 4." What can you tell Tisha?
6. How might engineers designing bridges use fractions?