MISSISSIPPI DEPARTMENT OF EDUCATION

Ensuring a bright future for every child

MISSISSIPPI

EXEMPLAR Units & Lessons

MATHEMATICS

Grade 7

Grant funded by:

W.K. KELLOGG FOUNDATION

Lesson 5: Solving Proportional Relationships

Focus Standard(s): 7.RP.2b, 7.RP.2c

Additional Standard(s): 7.RP.1

Standards for Mathematical Practice: SMP.1, SMP.2, SMP.4, SMP.6, SMP.8

Estimated Time: 90 minutes

Resources and Materials:

- Colored Paper
- Markers
- Scissors
- Glue
- Handout 5.1: Bellwork
- Handout 5.2: Teacher Notes on Multiple Strategies
- Handout 5.3: Using Equivalent Ratios
- Handout 5.4: Find Someone Who
- Handout 5.5: Pocket Book Instructions
- Handout 5.6: Card Sort
- Handout 5.7: Frayer Model

Lesson Target(s):

- Students will solve problems using equivalent ratios.
- Students will solve proportions using multiple strategies, including linear graphs.

Guiding Question(s):

- How can you determine whether two quantities are in a proportional relationship by testing for equivalent ratios in a table?
- How can you identify the constant of proportionality in tables and verbal descriptions of proportional relationships?

Vocabulary

Academic Vocabulary:	Instructional Strategies for Academic Vocabulary:
• Equivalent • Ratio • Proportional	☐ Introduce words with student-friendly definition and pictures ☐ Model how to use the words in discussion ☐ Read and discuss the meaning of words in a mathematical context ☐ Create pictures/symbols to represent words ☐ Write/discuss using the words

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will learn multiple strategies for solving proportional relationships.

Anticipatory Set/Introduction to the Lesson: Ratios of Users
Distribute **Handout 5.1: Bellwork**.

- ✓ Actively monitor students working independently to understand how a country with more people with cellphones has a lower ratio of cellphone users (SMP.1).

- ✓ Actively monitor and listen to team discussions comparing the number of cellphone users to the total population. Verifying an understanding of unit rate and how it relates to the population by asking the following prompting questions (SMP.4):

- How do the scenarios compare?
- How does the number of cellphones affect the ratios?
- How would a graph help represent this situation?
- How does the total population change your ratio?
- Which country is larger?

For students who are EL, have disabilities, or perform well below grade-level:

- Ask guiding questions about what is being compared to create the ratio.

Extensions for students with high interest or working above grade level:

- Students may look up populations and number of cellphones to prove theorems.

Activity 1: Using Equivalent Ratios

Note: Review **Handout 5.2: Teacher Notes on Multiple Strategies** and become familiar with a variety of strategies students can use to solve proportional relationships.

Facilitate whole group discussion on identifying proportional relationships in tables, graphs, and equations. Reinforce the characteristics of proportionality for students. Explain to students that when working with proportional relationships, there will be times when they will need to solve for a missing variable in one of the ratios. Provide students multiple methods for solving proportions, since some problems will include fractional answers. Encourage students to write solutions in fractional form to obtain the most precise answer, as well as use units where necessary (SMP.6).

T: Write $\frac{2}{5} = \frac{x}{15}$ on the board.

Allow students quiet think time to come up with ways to determine the value of x. Expect students with strong backgrounds solving equations to multiply by 15, while others may see that 15 is 3 times larger than 5, which means they need to find a number 3 times

larger than 2 for x (SMP.2 and SMP.8). Select students to share strategies with the class. Discuss any unique ideas and what mathematics supported their reasoning. Present students with additional strategies found in **Handout 5.2: Teacher Notes on Multiple Strategies**. These strategies include the Giant One, Undoing Division, Clearing Fractions, and Cross-Multiplication.

Pair students and distribute **Handout 5.3: Using Equivalent Ratios** to each pair. Upon completion, pairs will share with others and discuss which method is preferred.

- ✓ Actively monitor pairs and use the following prompts to engage all students:
  - Explain why you used that method.
  - Does the size of your numbers affect how you solve the ratio?
  - What is the equation for the table?
  - What is the y-intercept?
  - Does the unit rate change?

- ✓ Allow students time to reflect on which method they preferred when solving proportional equations. Have students share this self-assessment with their reasoning. Correct any misconceptions and validate any understandings. Determine if more support is needed for individuals or the whole class.

Activity 2: Find Someone Who

Distribute **Handout 5.4: Find Someone Who**. Allow students 10-15 minutes to fill in the three boxes of the table under the "My Way" column. Instruct students to stand up and find 3 people in the room who can solve each problem using a different method. Explain to students they cannot go to the same student more than once, so it is important for students to be selective of who they ask to work each problem. Instruct students to turn in sheet to teacher once all boxes are complete.

Note: This activity can be turned into a game, with rewards for students who complete the table first.

Collect all sheets and present one problem at a time, allowing students to present 4 different methods for solving. This will ensure the teacher exposes the class to multiple methods.

For students who are EL, have disabilities, or perform well below grade-level:

- Because the sheet allows the student to choose the first method, he/she may select what they find the easiest. As other students sign their paper using another method, they will be exposed to multiple strategies.
- Allow students to work in pairs to receive more support.

Extensions for students with high interest or working above grade level:

- Students consider methods outside of their comfort zone at times as they look for a different strategy. Encourage more advanced students to be Alternative Method #3, so they must dig deeper to find an unused method.

Activity 4: Pocket Book

✓ Provide students with one piece of colored paper, glue and **Handout 5.5: Pocket Book Instructions**. Have students assemble the pocket book and title the book as, "Proportional Relationships." On the inside, have students label the left pocket as "Proportional" and the right pocket as "Non-Proportional."

Distribute **Handout 5.6: Card Sort** and scissors. Instruct students to cut cards and sort them into two piles, "Proportional" and "Not Proportional." Before determining which pocket a card goes in, have students write their reasoning on the back of the card.

For students who are EL, have disabilities, or perform well below grade-level:

- Allow students to work in pairs.

Extensions for students with high interest or working above grade level:

- Have students use index cards to create their own examples of proportional and not proportional relationships.

Note: Additional time may be needed for students to practice the skills addressed this lesson. Use the formative assessments provided to determine which skills may need reinforcement before beginning Lesson 6. Continue to expose students to problems similar to those in Lesson 5 to allow students to develop fluency in solving proportions.

Reflection and Closing:
Encourage reflection on new material through journal writing. Supply students with a prompt explaining their experiences over the course of the unit as they have learned more about proportional relationships.

Allow students time to add new material to the Graffiti Wall.

For students who are EL, have disabilities, or perform well below grade-level:
- Responses can be written in a graphic organizer instead of paragraph form.

Homework

✓ Students will complete **Handout 5.7: Frayer Model** on Proportionality.

For students who are EL, have disabilities, or perform well below grade-level:
- Have samples of examples and non-examples for students to organize instead of create.

Handout 5.1: Bellwork

Name: _____ Date: _____

Word Problem:

If India has more cellphones than Italy, how is it possible that Italy has the higher ratio of cellphone owners?

Describe how this is possible:

Answer Key

Word Problem:

If India has more cellphones than Italy, how is it possible that Italy has the higher ratio of cellphone owners?

Describe how this is possible:

If the population of India is much higher than that of Italy, a lower ratio could still equal a higher number of cellphones.

Ex. India Population = 1.252 billion and Italy Population = 59.83 million

Because the population is so much larger, multiplying a unit rate that is a proper fraction will keep mean there are more cellphones in India, even though Italians are more likely to own a phone.

Handout 5.2: Teacher Notes on Multiple Strategies

Giant One Method

The Giant One method provides students with a visual of using the identity property of multiplication to create equivalent fractions. Students often do this without giving it a name.

Ex. $\frac{x}{16} = \frac{9}{2}$

$$\frac{x}{16} = \frac{9}{2} \bullet \boxed{1}$$

$$\frac{x}{16} = \frac{9 \cdot 8}{2 \cdot 8}$$

$$\frac{x}{16} = \frac{72}{16}$$

Since both denominators are now the same, that means the numerators are also equivalent, therefore, x = 72.

Note: Students may use a Giant One on both sides of the proportion if needed.

Undoing Division Method

The Undoing Division method is used to remove the denominator on under the variable. This is done by multiplying both sides of the proportion by the denominator, just as students would do to solve a one-step equation.

Ex. $\frac{5}{7} = \frac{x}{3}$

$$(3) \bullet \frac{5}{7} = \frac{x}{3} \bullet (3)$$

$$\frac{15}{7} = x$$

Clearing Fractions Method

In order to clear both fractions, students will multiply both sides of the proportion by both denominators. They will then solve the proportion like a one-step equation.

$$\text{Ex. } \frac{4}{9} = \frac{x}{15}$$

$$(9 \bullet 15) \bullet \frac{4}{9} = \frac{x}{15} \bullet (9 \bullet 15)$$

$$60 = 9x$$

$$\frac{20}{3} = x$$

Cross-Multiplication Method

Students can multiply opposite numerators and denominators and solve as a one-step equation.

$$\text{Ex. } \frac{2}{3} = \frac{14}{x}$$

$$2x = 42$$

$$x = 21$$

"Bat and Ball" Method

This trick is a visual of Cross-Multiplication, where students multiply the two numbers opposite one another and then divide by the remaining third number.

$$\text{Ex. } \frac{12}{8} = \frac{36}{x}$$

$$36 \cdot 8 = 288$$

$$288 \div 12 = 24$$

$$x = 24$$

Handout 5.3: Using Equivalent Ratios

Name: _____ Date: _____

Kiera can make seven bracelets in ten minutes. She read an article about a girl who made 1505 bracelets for charity, so she was curious how long it would take her to make that many without stopping.

a. Complete Kiera's table below, and then explain how you did so. How many minutes would it take Kiera to make 1505 bracelets? How many hours?

Bracelets	
Bracelets (#)	Time (minutes)
0	0
7	10
1505	?

b. Instead of solving this problem using a table or a graph, Kiera represented seven bracelets in ten minutes as the ratio $\frac{10\ minutes}{7\ bracelets}$. Then she wrote an equivalent ratio as follows:

$$\frac{10\ minutes}{7\ bracelets} = \frac{?\ minutes}{1505\ bracelets}$$

Use two different strategies to find the missing value in the equivalent ratio (Giant One, Undoing Division, Clearing Fractions, Cross-Multiplication).

Method 1:

Method 2:

Handout 5.4: Find Someone Who

Name: _____ Date: _____

Find Someone

Who…

Directions: Solve the 3 proportions below using the method of your choice. Then, find 3 people who can solve the proportions 3 ways different than you. You cannot use the same person more than once.

Problem 1: $\frac{9}{7} = \frac{27}{x}$	**Problem 2:** $\frac{14}{21} = \frac{x}{7}$	**Problem 3:** $\frac{2x}{25} = \frac{8}{100}$
My Way:	My Way:	My Way:
Alt. Method 1:	Alt. Method 1:	Alt. Method 1:
Alt. Method 2:	Alt. Method 2:	Alt. Method 2:
Alt. Method 3:	Alt. Method 3:	Alt. Method 3:

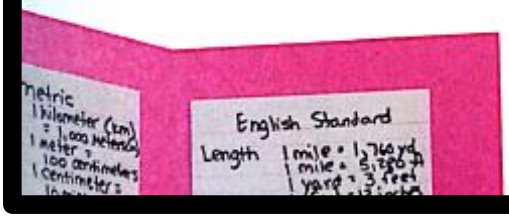
Handout 5.5: Pocket Book Instructions

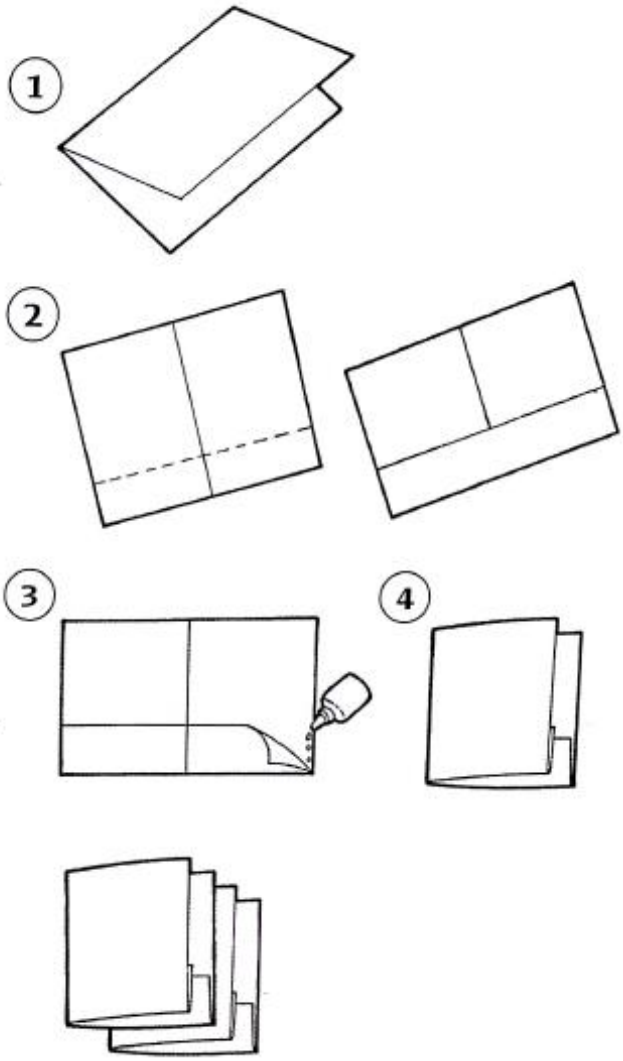
Pocket Book

1. Fold a sheet of paper (8 1/2" × 11") in half like a *hamburger.*
2. Open the folded paper and fold one of the long sides up two inches to form a pocket. Refold along the *hamburger* fold so that the newly formed pockets are on the inside.
3. Glue the outer edges of the two-inch fold with a small amount of glue.
4. **Optional:** Glue a cover around the *pocket book.*

   Variation: Make a multi-paged booklet by gluing several pockets side-by-side. Glue a cover around the multi-paged *pocket book.*

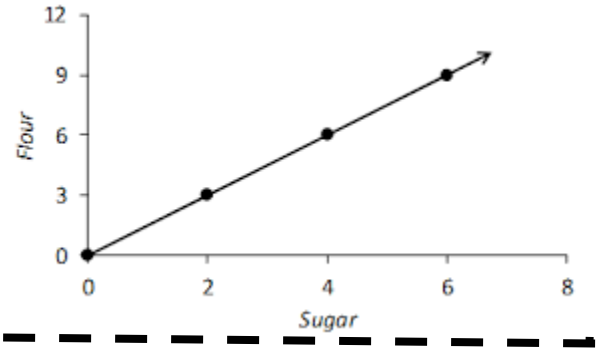
Use 3" × 5" index cards or quarter sheets of notebook paper inside the pockets.
Store student-made books, such as two-tab books and folded books in the pockets.

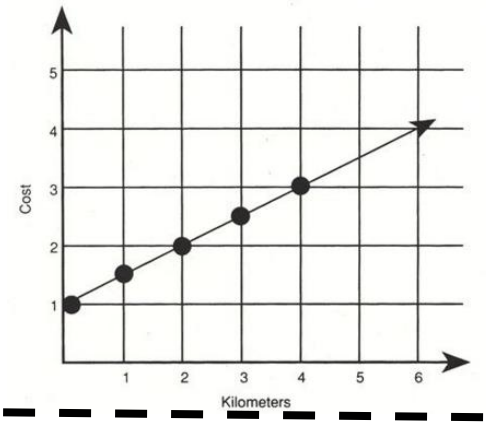


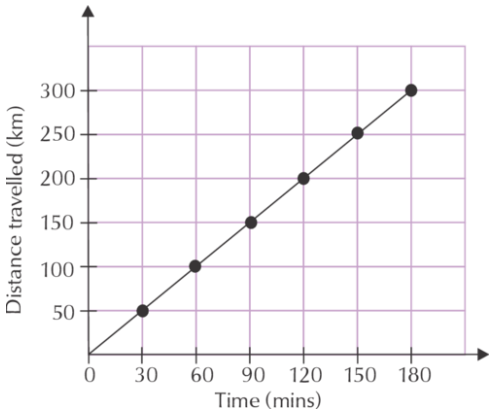


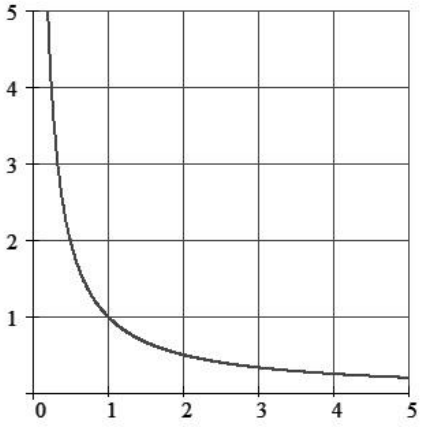
Foldables are 3D Graphic Organizers created by Dinah Zike. www.dinah.com

Handout 5.6: Card Sort









x	y
2	3
4	6
8	12
12	14

Number of Days	1	2	3	4
Hours Worked	6	12	18	24

M

Number of Roses	3	6	9	12	15
Price (Dollars)	9	18	27	36	45

ition 1

$y = 8x$

$y = 3x + 2$

$y = \frac{1}{2}x$

$y = -1x$

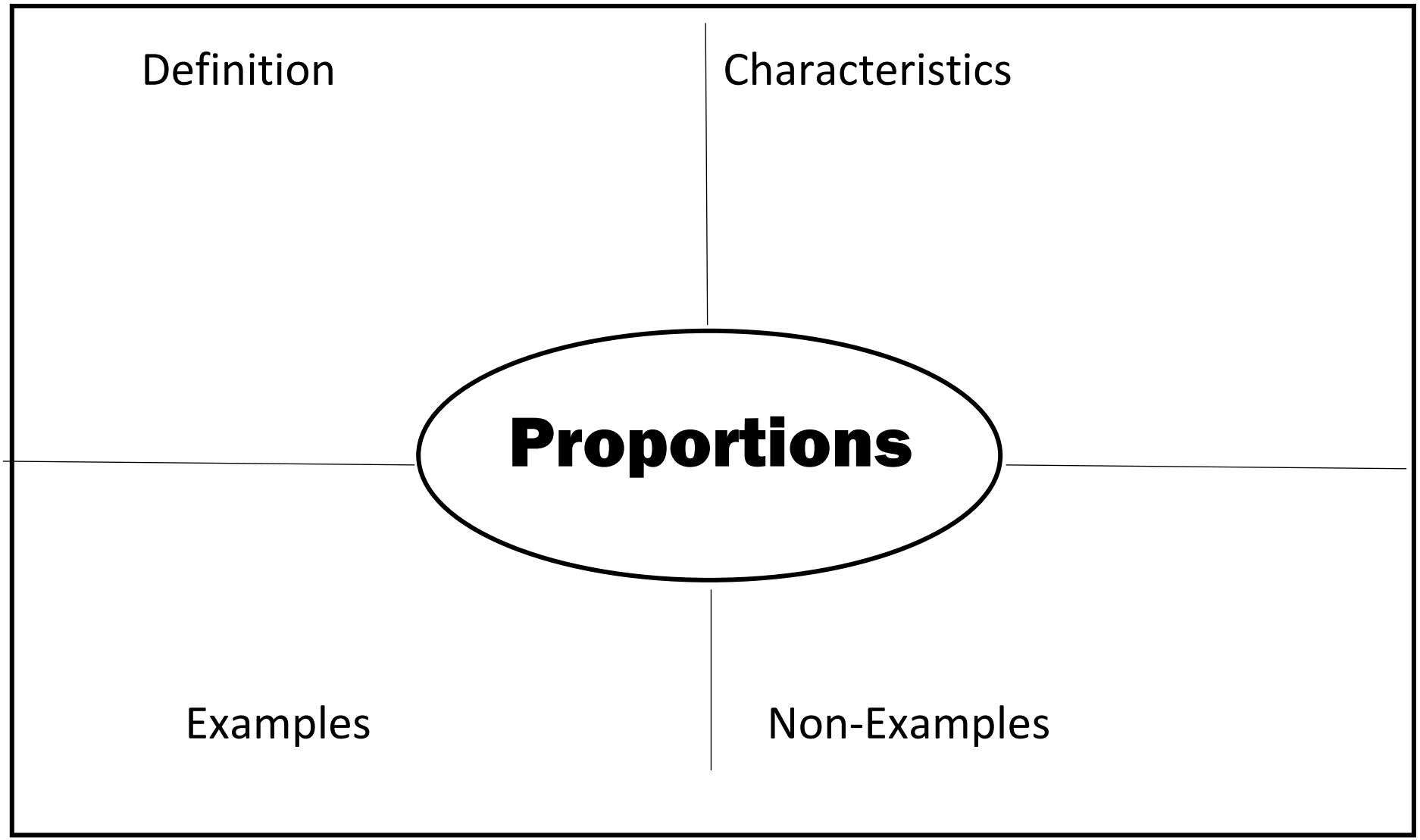
A pool is drained at a rate of 3 gallons per minute.

A restaurant sells 4 slices of pizza every 10 minutes.

A video game company marks a cost of $25 per game.

Amazon charges $15.99 for every book plus shipping.

Handout 5.7: Frayer Model Name: _____ Date: _____



For training or questions regarding this unit,
please contact:

exemplarunit@mdek12.org