LESSON 5: Proportional Relationships

[Objective]
The student will recognize and represent proportional relationships between quantities using ratios and tables.

[Prerequisite Skills]
simplifying fractions, multiplying, writing ratios, unit rates

[Materials]
Student pages **S38 – S47**
Colored pencils (1 set per student pair)

[Essential Questions]
1. Explain how to use fraction models to demonstrate a proportional relationship.
2. How do you know if two ratios form a proportion? Justify your answer.
3. Explain how to determine if two quantities in a table have a proportional relationship.

[Words For Word Wall]
equivalent fractions, proportion, cross products, ratio, proportional relationship, unit rate, means, extremes

[Grouping]
Cooperative Pairs (CP), Whole Group (WG), Individual (I)
*For Cooperative Pairs (CP) activities, assign the roles of Partner A and Partner B to students. This allows each student to be responsible for designated tasks within the lesson.

[Levels of Teacher Support]
Modeling (M), Guided Practice (GP), Independent Practice (IP)

[Multiple Representations]
SOLVE, Algebraic Formula, Verbal Description, Pictorial Representation, Graphic Organizer, Table

[Warm-Up] (IP, I, WG) S38 (Answers are on T88.)
- Have students turn to S38 in their books to begin the Warm-Up. Students will be determining unit rates. Monitor students to see if any of them need help during the Warm-Up. Give students time to complete the problems and then review the answers as a class. **{Algebraic Formula, Verbal Description}**

[Homework]
Take time to go over the homework from the previous night.

[Lesson] [1 – 2 Days (1 day = 80 minutes) – M, GP, WG, I, CP, IP]

SOLVE Problem (WG, GP) S39 (Answers on T89.)

Have students turn to S39 in their books. The first problem is a SOLVE problem. You are only going to complete the S step with students at this point. Tell students that during the lesson they will learn how to determine if two quantities in a ratio or table have a proportional relationship. They will use this knowledge to complete this SOLVE problem at the end of the lesson. **{SOLVE, Graphic Organizer, Verbal Description, Table}**

Equivalent Fractions (M, WG, GP, CP, IP) S39, S40 (Answers on T89, T90.)

M, GP, WG, CP: Students will use the pictorial representation of fractions to build the foundation for proportional relationships. Make sure students know their designation as Partner A or Partner B. **{Pictorial Representation, Verbal Description, Graphic Organizer}**

MODELING

Equivalent Fractions

Step 1: Have student pairs discuss what they know about equivalent fractions.

- Have partners create a list and write a short definition for their student pair. Have student pairs share answers with the whole class.
- Compile a class definition for equivalent fractions. (Possible answers provided: They are fractions that name the same amount with different numbers. They are fractions that have the same value with a different name.)

Step 2: Partner A, how many sections are in the first fraction bar? (4)

- Partner B, what part of the fraction does this represent? (denominator)
- Have students use a yellow colored pencil to color in three of the four sections in the first fraction bar to match the fraction strips.
- Identify the fraction that is represented with 3 of the 4 sections colored. ($\frac{3}{4}$) Record the fraction below the fraction bar.

Step 3: How can we create a pictorial example of the fractions $\frac{6}{8}$ and $\frac{9}{12}$?

- Have Partner A tell their partner what the denominator represents. (The number of equal pieces the bar is split into.)
- Have Partner B tell their partner what the numerator represents. (The number of pieces that need to be shaded.)
- Have students color the bars to make pictorial representations of the two fractions.

Step 4: Have students compare the three fraction bars.

- Partner A, what can you say about the relationship between the three fractions? (They are **equivalent fractions**.) Record.

- Partner B, explain how you know they are equivalent. (When we compare the shaded amounts in the fraction bars, they are equal.) Record.
- Have the partners discuss the possible relationship they see between the numerators and denominators.

Step 5: Partner A, explain how to show that $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent without a model. ($\frac{3}{4} \times \frac{2}{2} = \frac{6}{8}$; We multiply both the numerator and denominator by 2.) Record.

- Partner B, explain why we can multiply $\frac{3}{4}$ by $\frac{2}{2}$ to find an equivalent fraction. (The fraction $\frac{2}{2}$ is equal to 1, so we can multiply without changing the value.) Record.

Step 6: Partner A, explain how to show that $\frac{3}{4}$ and $\frac{9}{12}$ are equivalent without a model. ($\frac{3}{4} \times \frac{3}{3} = \frac{9}{12}$; We multiply both the numerator and denominator by 3.) Record.

- Partner B, explain why we can multiply $\frac{3}{4}$ by $\frac{3}{3}$ to find an equivalent fraction. (The fraction $\frac{3}{3}$ is equal to 1, so we can multiply without changing the value.) Record.

Step 7: Have student pairs turn to page S40 and work together to shade the models to match the fractions below each fraction bar.

Step 8: Have students compare the three fraction bars.

- Partner A, what can you say about the relationship between the three fractions? (They are equivalent.) Record.
- Partner B, explain how you know they are equivalent. (When we compare the shaded amounts in the fraction bars, they are the equal.) Record.

Step 9: Partner A, explain how to show that $\frac{8}{12}$ and $\frac{4}{6}$ are equivalent without a model. ($\frac{8}{12} \div \frac{2}{2} = \frac{4}{6}$; We divide both the numerator and denominator by 2.) Record.

- Partner B, explain why we can divide $\frac{8}{12}$ by $\frac{2}{2}$ to find an equivalent fraction. (The fraction $\frac{2}{2}$ is equal to 1, so we can divide without changing the value.) Record.

Step 10: Partner A, explain how to show that $\frac{4}{6}$ and $\frac{2}{3}$ are equivalent without a model. ($\frac{4}{6} \div \frac{2}{2} = \frac{2}{3}$; We multiply both the numerator and denominator by 2.) Record.

- Partner B, explain why we can divide $\frac{4}{6}$ by $\frac{2}{2}$ to find an equivalent fraction. (The fraction $\frac{2}{2}$ is equal to 1, so we can divide without changing the value.) Record.

Step 11: Partner A, you can find an equivalent fraction by (multiplying) both the numerator and the denominator by the (same) number. Record.

- Partner B, you can find an equivalent fraction by (dividing) both the numerator and the denominator by the (same) number. Record.

IP, CP, WG: Have student pairs complete Problems 11 – 16 at the bottom of the page. After students have completed the problems, review the answers as a whole group. **{Verbal Description}**

Introduction to Mean and Extremes

(M, GP, WG, CP, IP) S41, S42 (Answers on T91, T92.)

M, GP, WG, CP: Have students turn to S41 in their books. Students will work with cross products in fractions to determine if the relationship between the fractions is proportional. Make sure students know their designation as Partner A or Partner B. **{Algebraic Formula, Verbal Description, Graphic Organizer.}**

MODELING

Introduction to Means and Extremes

Step 1: Have partners discuss Questions 1 and 2 and then share answers as a whole class. Some students may need help with the questions.

- Partner A, what are the three ways that we can write a **ratio**? (as a fraction, with a colon, or with the word "to") Record.
- Partner B, when two ratios are equivalent what do they form? (a proportion) Record. We know the two fractions shown after Question 2 are equivalent or a **proportion** because there is an equal sign between them. Both the numerator and denominator can be multiplied by 2 to create an equivalent fraction.

Step 2: Using that proportion, look at Question 3.

- Partner A, how can we rewrite our proportion using the colons? (3:4) (6:8) Record.
- Partner B, read the proportion using words. (3 is to 4 as 6 is to 8) Record.

Step 3: When we write the two ratios as 3:4 as 6:8, there are two numbers in the middle.

- Partner A, identify the two numbers in the middle. (4, 6) Record. The two values in the middle are called the **means**. Remember that mean is a type of average and that may help you remember that the means are the middle numbers.
- Partner B, identify the two numbers on the outside. (3, 8) Record. The two values on the outside are called the **extremes**. These two values are at the extreme beginning and extreme end of the proportion.

Step 4: Direct students' attention to the graphic organizer. This chart shows the fraction pair, the means and extremes, and also there are two columns labeled "Product of the Means" and "Product of the Extremes."

Fractions	Means	Product of the Means	Extremes	Product of the Extremes	Are the Products equal?
$\frac{3}{4} = \frac{6}{8}$ 3:4 as 6:8	4, 6	4 • 6 = 24	3, 8	3 • 8 = 24	Yes

- Partner A, what is the product of the two values that are the means? (24) Record.
- Partner B, what is the product of the two values that are the extremes? (24) Record.

Step 5: If the two ratios are proportional, then the products of the means and the extremes must be equal. Complete the answers to Question 7.

IP, CP, WG: Have student pairs complete the chart on the top of S42 and then discuss the answers as a whole group. **{Verbal Description, Pictorial Representation, Graphic Organizer}**

Proportions with Cross Products (M, GP, WG, CP, IP) S42 (Answers on T92.)

M, GP, WG, CP: Have students turn to S42 in their books. Students will work with relationships in tables to determine if the relationships are proportional. Make sure students know their designation as Partner A or Partner B. **{Verbal Description, Graphic Organizer}**

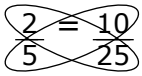
MODELING

Proportions with Cross Products

Step 1: Direct students' attention to the questions below the graphic organizer on S42.

- Partner A, what do you notice about the products of the means and extremes for each fraction pair? (The product for each fraction pair is the same value.) Record.

Step 2: As we look at Problem 1 from the graphic organizer, circle the two values that are the means and the two values that are the extremes.



Step 3: What do you notice about the product of the numbers that are circled? (They are the same.) Sometimes the products of the means and the product of the extremes are called **cross products**.

- We can then say that the two fractions have a **proportional relationship** if the (cross products) are equal. Record.

Step 4: Model the process of multiplying the cross products for Question 5 and then have students work with their partner on Questions 6 – 8 at the bottom of S42 to determine if the fractions have a proportional relationship. Have students share and defend their answers to the group.

Proportional Relationships in Tables

(M, GP, WG, CP, IP) S43, S44
(Answers on T93, T94)

M, GP, WG, CP: Have students turn to S43 in their books. Students will work with relationships in tables to determine if the relationships are proportional. Make sure students know their designation as Partner A or Partner B. **{Algebraic Formula, Verbal Description, Graphic Organizer, Table}**

MODELING

Proportional Relationships in Tables

Step 1: Direct students' attention to the table in Problem 1.

- Partner A, what is the label of the top row of the chart? (roses)
- Partner B, identify the label for Row 2 of the chart. (floral arrangements)

Step 2: Have students write the four different ratios that are represented in the table. ($\frac{6}{1}$, $\frac{12}{2}$, $\frac{18}{3}$, $\frac{24}{4}$) Record in Question 2.

- Partner A, how can you tell if the relationship between the two quantities is a proportional relationship? (Write ratios and compare.) Record.
- Partner B, how did we tell if two ratios were in a proportional relationship? (Find the cross products, and if they are equal there is a proportional relationship.) Record.

Step 3: Partner A, how many ratios can we compare at one time using cross products? (two)

- Partner B, how many ratios do we have in our chart? (four) Explain to students that we would have to find the cross products three times to make sure they were all equivalent.
- Partner A, do you notice anything special about the first ratio in the table? (The denominator is 1. It is a **unit rate**.) Record.
- Partner B, Do you know a way we can write the other ratios as unit rates? (Yes, we can divide the numerator and denominator by the denominator or simplify the fraction.)

Step 4: Simplify the second ratio of $\frac{12}{2}$, dividing both numerator and denominator by 2. Then have Partner A write a unit rate for $\frac{18}{3}$ and Partner B write a unit rate for $\frac{24}{4}$.

- Do all the ratios simplify to the same unit rate? (Yes, they are the same unit rate.) Record.
- Complete Question 7 on S43. When ratios simplify to the same unit rate, the quantities in those ratios form a proportional relationship. Record.

Step 5: Work through Problems 8 – 12 with students at the top of S44 using the same process from Steps 3 and 4.

IP, CP, WG: Have students work with a partner to complete Problems 1 and 2 on the bottom of S44. Have students come back together as a class and share their results. **{Graphic Organizer, Algebraic Formula, Verbal Description}**

SOLVE Problem **(GP, WG) S45 (Answers on T95.)**

Remind students that the SOLVE problem on S45 is the same one from the beginning of the lesson. Complete the SOLVE problem with your students. Ask them for possible connections from the SOLVE problem to the lesson. (Students should say that they need to write ratios between agendas and cost to find unit rates to see if they are equivalent.) **{SOLVE, Table, Verbal Description, Graphic Organizer}**

If time permits... **(CP, IP) S46 (Answers on T96.)**

Have students complete Problems 1- 10 on S46.

[Closure]

To wrap up the lesson, go back to the essential questions and discuss them with students.

- Explain how to use fraction models to demonstrate a proportional relationship. *(Shade the fraction you are modeling for each fraction bar and if the amount shaded on the bars is the same, then the fractions are equivalent and the relationship is proportional.)*
- How do you know if two ratios form a proportion? Justify your answer. *(If the ratios are equivalent fractions, or if the cross products are equal, we can say that the two ratios form a proportion.)*
- Explain how to determine if two quantities in a table have a proportional relationship. *(Write the ratios for each relationship between the two quantities and find the unit rates. If all the unit rates are equivalent, they have a proportional relationship.)*

[Homework] Assign S47 for homework. (Answers on T97.)

[Quiz Answers] T98 – T101

1. **C** 2. **B** 3. **D** 4. **B** 5. **A** 6. **B** 7. **C** 8. **D** 9. **A** 10. **C**

The quiz can be used at anytime as extra homework or to assess how students progress on writing equivalent fractions, solving proportions, and using tables to see if two quantities have a proportional relationship.

Here is the key to **S38**.

Warm–Up

Directions: Find the unit rate in each problem.

1. A six-pack of soda costs $3.36. How much does one soda cost?

$0.56 per can

2. A car travels 605 miles in 11 hours. What is the average number of miles traveled per hour?

55 miles per hour

3. What is the cost per pound? $\frac{\$5.48}{4 \text{ pounds of grapes}}$

$1.37 per pound

4. Alex has a set of 9 music discs from the 1970's. There are 126 total songs on the discs. What is the average number of songs per disc?

14 songs per disc

5. What is the average miles per hour? $\frac{\frac{1}{4} \text{ of a mile}}{\frac{1}{6} \text{ of an hour}}$

$1\frac{1}{2}$ miles per hour

Here is the key to **S39**.

Directions: Complete the following SOLVE problem with your teacher. You will only complete the S step.

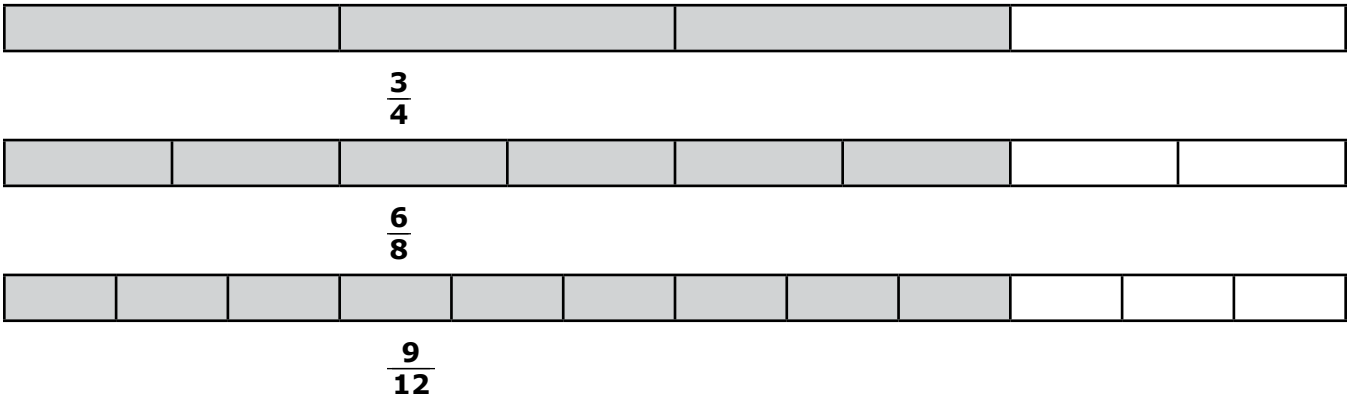
A printing shop is making agendas for different middle schools in the area. Four of the middle schools are in the chart below. Listed below each school is the number of agendas and the price paid to the printing shop. Do the number of agendas and the cost form a proportional relationship?

Middle School	South Middle School	East Middle School	North Middle School	West Middle School
Number of Agendas	65	52	41	58
Cost	$585.00	$468.00	$369.00	$522.00

S Underline the question.
This problem is asking me to find **whether there is a proportional relationship between the number of agendas and the cost.**

Directions: Complete this page with your teacher and partner.

1. Look at the models below. Write a fraction to represent each model.

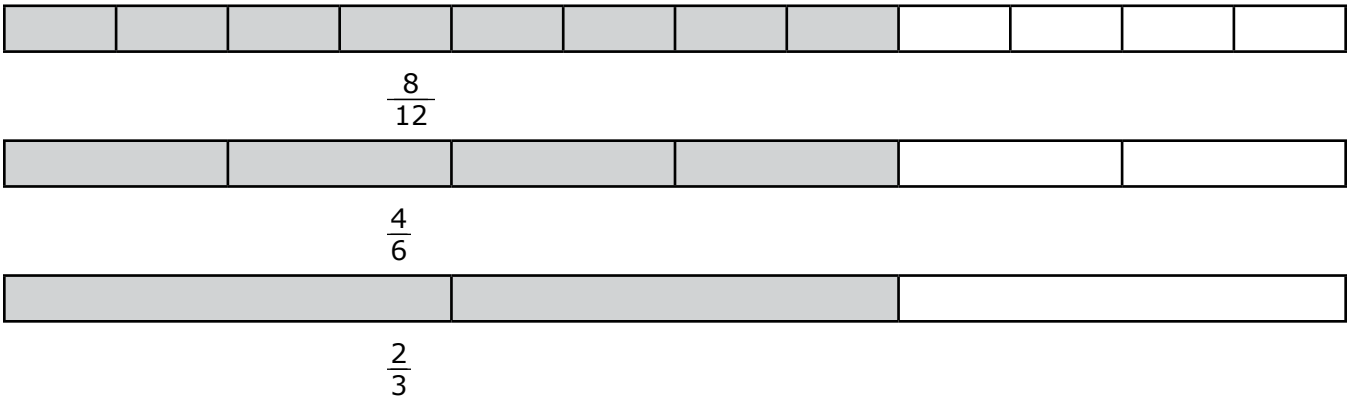


2. Describe the relationship between the three fractions. Explain your thinking.	**The fractions are equivalent. When we compare the shaded amounts in the three fraction bars, they are equal.**
3. Explain how to show that $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent without a model.	**$\frac{3}{4} \times \frac{2}{2} = \frac{6}{8}$; We multiply both the numerator and denominator by 2. The fraction $\frac{2}{2}$ is equal to 1, so we can multiply without changing the value.**
4. Explain how to show that $\frac{3}{4}$ and $\frac{9}{12}$ are equivalent without a model.	**$\frac{3}{4} \times \frac{3}{3} = \frac{9}{12}$; We multiply both the numerator and denominator by 3. The fraction $\frac{3}{3}$ is equal to 1 so we can multiply without changing the value.**

Here is the key to **S40**.

Directions: Complete this page with your teacher and partner.

5. Color the models below to show the fractions listed underneath them.



6. Describe the relationship between the three fractions. Explain your thinking.	**The fractions are equivalent. When we compare the shaded amounts in the fraction bars, they are the equal.**
7. Explain how to show that $\frac{8}{12}$ and $\frac{4}{6}$ are equivalent without a model.	**$\frac{8}{12} \div \frac{2}{2} = \frac{4}{6}$; We divide both the numerator and denominator by 2. The fraction $\frac{2}{2}$ is equal to 1, so we can divide without changing the value.**
8. Explain how to show that $\frac{4}{6}$ and $\frac{2}{3}$ are equivalent without a model.	**$\frac{4}{6} \div \frac{2}{2} = \frac{2}{3}$; We divide both the numerator and denominator by 2. The fraction $\frac{2}{2}$ is equal to 1, so we can divide without changing the value.**

9. You can find an equivalent fraction by **multiplying** both the numerator and the denominator by the **same** number.

10. You can find an equivalent fraction by **dividing** both the numerator and the denominator by the **same** number.

Directions: Complete the following pairs of equivalent fractions by multiplying or dividing.

11. $\frac{2}{5} \bullet \frac{5}{5} = \mathbf{\frac{10}{25}}$

12. $\frac{21}{49} \div \frac{7}{7} = \mathbf{\frac{3}{7}}$

13. $\frac{4}{11} \bullet \frac{11}{11} = \mathbf{\frac{44}{121}}$

14. $\frac{3}{5} \bullet \frac{3}{3} = \mathbf{\frac{9}{15}}$

15. $\frac{9}{10} \bullet \frac{5}{5} = \mathbf{\frac{45}{50}}$

16. $\frac{24}{36} \div \frac{12}{12} = \mathbf{\frac{2}{3}}$

Here is the key to **S41**.

Directions: Complete this page with your teacher and partner.

1. What are the three ways that we can write ratios? **as a fraction, with a colon, or with the word "to"**

2. When two ratios are equivalent they form **a proportion**.
Let's look at the proportion $\frac{3}{4} = \frac{6}{8}$. We can make equivalent fractions. $\frac{3}{4} \bullet \frac{2}{2} = \frac{6}{8}$

3. This means that we can rewrite our proportion as **3:4** as **6:8**. When we read that proportion we would say, **3** is to **4** as **6** is to **8**.

4. When we write the two ratios 3:4 as 6:8, which two numbers are in the middle? **4, 6** The two values in the middle are called the **means**.

5. When we write the two ratios 3:4 as 6:8, which two numbers are on the outside? **3, 8** The two values on the outside are called the **extremes**.

Look at the example in the graphic organizer below. The proportion has been rewritten with colons to make it easier to identify the **means** and **extremes**.

Problem Number	Fractions	Means	Product of the Means	Extremes	Product of the Extremes	Are the Products equal?
Example	$\frac{3}{4} = \frac{6}{8}$ 3:4 as 6:8	**4, 6**	**4 • 6 = 24**	**3, 8**	**3 • 8 = 24**	**Yes**

6. What is the product when we multiply the means? (4 • 6) **24**

What is the product when we multiply the extremes? (3 • 8) **24**

7. Are the products equal? **Yes** If the products are equal, then the two fractions form a **proportional relationship**.

Here is the key to **S42**.

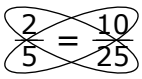
Directions: Complete this page with your teacher and partner.

Complete the following table with your partner for Problems 1 - 4.

Problem Number	Fractions	Means	Product of the Means	Extremes	Product of the Extremes	Are the products equal?
1	$\frac{2}{5} = \frac{10}{25}$ **2:5 as 10:25**	**5, 10**	**5 • 10 = 50**	**2, 25**	**2 • 25 = 50**	**Yes**
2	$\frac{21}{49} = \frac{3}{7}$ **21:49 as 3:7**	**49, 3**	**49 • 3 = 147**	**21, 7**	**21 • 7 = 147**	**Yes**
3	$\frac{4}{11} = \frac{44}{121}$ **4:11 as 44:121**	**11, 44**	**11 • 44 = 484**	**4, 121**	**4 • 121 = 484**	**Yes**
4	$\frac{3}{5} = \frac{9}{15}$ **3:5 as 9:15**	**5, 9**	**5 • 9 = 45**	**3, 15**	**3 • 15 = 45**	**Yes**

What do you notice about each set of the products of the means and the extremes for each fraction pair? **The product for each fraction pair is the same value**.

Below is Problem 1 from the graphic organizer



2 • 25 = 50; 5 • 10 = 50

Sometimes the product of the means and the product of the extremes are called **cross products** of the proportion.

Two fractions have a proportional relationship if the **cross products** are equal.

Directions: Multiply the cross products to determine if the following fractions have a proportional relationship.

5. $\frac{5}{7}$ and $\frac{10}{14}$ **Yes, 70 = 70**

6. $\frac{2}{3}$ and $\frac{15}{20}$ **No, 40 ≠ 45**

7. $\frac{3}{4}$ and $\frac{9}{12}$ **Yes, 36 = 36**

8. $\frac{3}{4}$ and $\frac{7}{8}$ **No, 24 ≠ 28**

Here is the key to **S43**.

Directions: Complete this page with your teacher and partner.

You can also use tables to determine and display proportional relationships.

1. The table shows the number of roses it takes to make a certain number of floral arrangements.

Roses	6	12	18	24
Floral Arrangements	1	2	3	4

2. We can write four different ratios comparing the number of roses to the number of floral arrangements. $\frac{6}{1}, \frac{12}{2}, \frac{18}{3}, \frac{24}{4}$

3. How can you tell if the relationship between roses and floral arrangements is a proportional relationship? **Write ratios and compare**.

4. How did we tell if two ratios were in a proportional relationship? **We found the cross products. If they were equal, there was a proportional relationship**.

5. Since we have four ratios, we would have to compare each ratio to every other ratio in order to use cross products. That might take some time. What do you notice about the first ratio we wrote? **The denominator is 1. It is a unit rate**.

6. We could simplify each ratio to a unit rate to see if they are all the same. Are they all the same?

$\frac{6}{1}, \frac{12}{2} \div \frac{2}{2} = \frac{6}{1}, \frac{18}{3} \div \frac{3}{3} = \frac{6}{1}, \frac{24}{4} \div \frac{4}{4} = \frac{6}{1}$**; Yes, they are the same unit rate.**

7. When ratios simplify to the same unit rate, the quantities in those ratios form a **proportional relationship**.

Here is the key to **S44**.

Directions: Complete this page with your teacher and partner.

8. Let's look at another relationship to see if we can use unit rates to determine proportional relationships.
The table shows the number of miles a boat has traveled in a certain number of hours.

Hours	1	2	4	7
Miles	45	90	180	315

9. Write the ratios in miles per hour and find all the unit rates.
$\frac{45}{1}, \frac{90}{2} \div \frac{2}{2} = \frac{45}{1}, \frac{180}{4} \div \frac{4}{4} = \frac{45}{1}, \frac{315}{7} \div \frac{7}{7} = \frac{45}{1}$

10. Can all the ratios be simplified to the same unit rate? **Yes, they are all the same unit rate**.

11. What is the unit rate? $\frac{45}{1}$

12. How do you know when two quantities in a table form a proportional relationship?
They can all be simplified to the same unit rate.

Directions: Complete this section with your partner.
Do the following tables represent proportional relationships? How do you know?

1. The chart shows how much customers paid for cherries at the grocery store.

Pounds	1	2	5	6
Cost	$2.50	$5.00	$12.50	$15.00

Yes, the unit rates are the same.

$\frac{2.50}{1}, \frac{5.00}{2} \div \frac{2}{2} = \frac{2.50}{1}, \frac{12.50}{5} \div \frac{5}{5} = \frac{2.50}{1}, \frac{15.00}{6} \div \frac{6}{6} = \frac{2.50}{1}$

2. The chart shows the number of miles Mike traveled for the total number of hours in a bike race.

Hours	1	2	3	4
Miles	10	18	27	32

No, the unit rates are not the same.

$\frac{10}{1}, \frac{18}{2} \div \frac{2}{2} = \frac{9}{1}, \frac{27}{3} \div \frac{3}{3} = \frac{9}{1}, \frac{32}{4} \div \frac{4}{4} = \frac{8}{1}$

Here is the key to **S45**.

Directions: Complete the following SOLVE problem with your teacher.

~~A printing shop is making agendas for different middle schools in the area~~. | Four of the middle schools are in the chart below. | Listed below each school is the number of agendas | and the price paid to the printing shop. | Do the number of agendas and the cost form a proportional relationship?

Middle School	South Middle School	East Middle School	North Middle School	West Middle School
Number of Agendas	65	52	41	58
Cost	$585.00	$468.00	$369.00	$522.00

S Underline the question.
This problem is asking me to find **whether there is a proportional relationship between the number of agendas and the cost.**

O Identify the facts.
Eliminate the unnecessary facts.
List the necessary facts.
S – 65 agendas - $585.00, E – 52 agendas - $468.00,
N – 41 agendas - $369.00,W – 58 agendas - $522.00

L Write in words what your plan of action will be. **Set up a ratio comparing cost to number of agendas for each school. Divide by the number of agendas in each ratio to get a unit rate. Check to see if all unit rates (ratios) are equal**.
Choose an operation or operations. **Division**

V Estimate your answer.
The agendas are less than $10 each and have the same unit cost.

Carry out your plan. **S -** $\frac{585}{65} = \frac{9}{1}$, **E -** $\frac{468}{52} = \frac{9}{1}$, **N -** $\frac{369}{41} = \frac{9}{1}$, **W -** $\frac{522}{58} = \frac{9}{1}$

E Does your answer make sense? (Compare your answer to the question.)
Yes, I found the unit rate per agenda cost.
Is your answer reasonable? (Compare your answer to the estimate.)
Yes, because $9 is close to my estimate of less than $10.
Is your answer accurate? (Check your work.) **Yes**
Write your answer in a complete sentence. **The relationship between the number of agendas and the cost is proportional because each ratio simplifies to the same unit rate of $9.00 per agenda.**

Here is the key to **S46**.

Directions: Solve the following problems using what you have learned about proportions.

1. $\frac{3}{n} = \frac{21}{35}$ **2.** $\frac{20}{8} = \frac{5}{n}$ **3.** $\frac{n}{4} = \frac{18}{6}$

***n* = 5** ***n* = 2** ***n* = 12**

Directions: Tell whether the quantities in the following ratios and tables form proportional relationships.

4. $\frac{4}{9}, \frac{12}{36}$ **5.** $\frac{8}{13}, \frac{64}{104}$ **6.** $\frac{5}{11}, \frac{55}{111}$

No, the cross products are 144 and 108. **Yes, the cross products are both 832.** **No, the cross products are 555 and 605.**

7.

x	1	2	3	4
y	4	8	12	16

Yes, all ratios simplify to a unit rate of 4:1.

8.

Gym Membership per month	1	2	3	4
Cost	$50	$75	$100	$125

No, all ratios do not simplify to the same unit rate.

9.

Babysitting hours	1	4	6	10
$ Earned	$12	$48	$72	$120

Yes, all ratios simplify to a unit rate of 12:1.

10.

Number of Books Purchased	1	2	3	4
Cost	$20	$30	$40	$50

No, all ratios do not simplify to the same unit rate.

Here is the key to **S47**.

Homework

Name _____ Date _____

Directions: Write an equivalent fraction for each fraction below.

1. $\frac{5}{8} = \frac{\mathbf{10}}{\mathbf{16}}$ **2.** $\frac{6}{7} = \frac{\mathbf{12}}{\mathbf{14}}$ **3.** $\frac{2}{7} = \frac{\mathbf{4}}{\mathbf{14}}$

Answers will vary. Sample answers given.

Directions: Solve each proportion.

4. $\frac{3}{2} = \frac{24}{x}$ **5.** $\frac{x}{40} = \frac{9}{10}$ **6.** $\frac{3}{6} = \frac{4}{x}$

***x* = 16** ***x* = 36** ***x* = 8**

Directions: Tell whether the quantities in the following ratios and tables form proportional relationships.

7.

x	2	3	5	8
y	8	9	20	28

No

8.

x	1	3	5	9
y	$2.30	$6.90	$11.50	$20.70

Yes

9. Lunch Cost

Number of lunches	1	2	3	4
Lunch Cost	$8	$16	$24	$32

Yes

10. Jack's Car

Number of miles driven	100	150	200	250
Gas used in gallons	3	5.5	9	11.8

No

LESSON 5: Proportional Relationships

Name _____ Date _____

Quiz

1. Which of the following is **not** an equivalent fraction for $\frac{7}{10}$?

A. $\frac{35}{50}$

B. $\frac{21}{30}$

C. $\frac{48}{70}$

D. $\frac{70}{100}$

2. Which of the following fractions is equivalent to $\frac{6}{18}$?

A. $\frac{3}{8}$

B. $\frac{3}{9}$

C. $\frac{10}{22}$

D. $\frac{12}{24}$

3. Which of the following shows a proportional relationship?

A. $\frac{3}{5} = \frac{8}{10}$

B. $\frac{4}{7} = \frac{9}{12}$

C. $\frac{2}{9} = \frac{6}{13}$

D. $\frac{5}{6} = \frac{20}{24}$

4. Which of the following does **not** show a proportional relationship?

A. $\frac{7}{12} = \frac{28}{48}$

B. $\frac{6}{11} = \frac{36}{41}$

C. $\frac{18}{24} = \frac{6}{8}$

D. $\frac{9}{12} = \frac{3}{4}$

5. Solve the proportion for x.

$\frac{4}{x} = \frac{48}{60}$

A. 5

B. 6

C. 12

D. 16

6. Solve for n.

$\frac{15}{5} = \frac{9}{n}$

A. 2

B. 3

C. 4

D. 8

7. Larry makes leather wallets to sell. The charts below show the total number of wallets he expects to make over the next few weeks. Which shows a proportional relationship between the number of weeks and the number of wallets he will make?

A.

Weeks	2	3	5	6
Wallets	8	12	16	20

B.

Weeks	2	3	5	6
Wallets	6	9	12	18

C.

Weeks	2	3	5	6
Wallets	10	15	25	30

D.

Weeks	2	3	5	6
Wallets	9	15	20	27

8. Which table does **not** show a proportional relationship?

A.

x	7	17.5	28	38.5
y	2	5	8	11

B.

x	24	48	72	120
y	2	4	6	10

C.

x	18	54	111	150
y	6	18	37	50

D.

x	54	74	109	126
y	6	8	12	14

9. Which statement is true about tables that show proportional relationships?

A. The table is made up of ratios that are proportional and have the same unit rate.

B. The table must start with an x-value of 1.

C. The table must have 4 values.

D. The table has the x and y values reversed.

10. Which table shows a proportional relationship?

A.

x	2	5	8	10
y	3	6	9	11

B.

x	1	2	3	4
y	4	6	8	10

C.

x	3	6	9	15
y	12	24	36	60

D.

x	5	10	15	20
y	7	12	17	22