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Units *&* Lessons
MATHEMATICS

Grade 7

Lesson 3: Comparing Tables and Graphs

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

Additional Standard(s): 7.RP.1

Standards for Mathematical Practice: SMP.1, SMP.3, SMP.5, SMP.8

Estimated Time: 90 minutes

Resources and Materials:
- Ruler
- Graph Paper
- Handout 3.1: Characteristics of Proportionality
- Handout 3.2: Comparing Tables and Graphs
- Handout 3.3: The Importance of (1, y)
- Desmos Graphing Calculator: www.desmos.com/calculator

Lesson Target(s):
- Students will discover what makes two quantities proportional.
- Students will recognize proportional relationships on tables and graphs.

Guiding Question(s):
- How can you determine if two quantities are proportional?
- How can you recognize a proportional relationship on a table and a graph?

Vocabulary

Academic Vocabulary:	Instructional Strategies for Academic Vocabulary:
- Unit Rate - Constant of Proportionality - Proportional	☐ Introduce words with student-friendly definitions and pictures ☐ Model how to use the words in discussion

| | Linear |
| | Ratio |

- Linear
- Ratio

☐ 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 use what they have previously learned to compare different representations of proportional relationships. Students will identify traits of proportionality in tables and graphs.

Anticipatory Set/Introduction to the Lesson: Real-World Proportions
Instruct students to create a real-world scenario they believe to be proportional. Select students to share examples with the class and discuss whether they agree with examples.

Facilitate group discussion using the following prompting questions:
- Do you agree that this situation represents a proportional relationship?
- What indicates that this is a (non)proportional relationship?
- What is the rule for your relationship?
- Does your relationship include the origin?

Activity 1: Characteristics of Proportional Graphs
Distribute **Handout 3.1: Characteristics of Proportionality**. Have students independently create a table of values for each situation.

Note: Give students additional support as needed when they encounter scenarios with y-intercepts that are not the origin. Ask the following guiding questions to assist in making connections between the characteristics of proportionality and the representations:

- Is the y-intercept the origin?
- If the x-value is zero, does that mean the y-value will also be zero?
- When a baby is born (0 days old), is the weight of the baby zero?
- If you spend zero hours working, what will you accomplish?
- How did you choose to set up the table?
- Does your table contain a unit rate?
- Is the relationship linear?

Lead a whole group discussion. Select students to share and justify responses for each scenario analyzed (SMP.3).

Explain that a table is only one method of representation. Ask students to brainstorm another representation they can create from a table. Verify student understanding of creating graphs from a table. Instruct students to create graphs for the three tables they used.

Note: Model how students should organize the coordinate plane with title, labels, and scaling (SMP.5).

Facilitate whole group instruction comparing tables and graphs. Ask students to identify which graphs are proportional. Have students list what characteristics the proportional graphs have that differ from the nonproportional graphs. Verify that students identify that part (b) does not begin at the origin and part (c) does not begin at the origin and is curved/non-linear.

Invite students to add new ideas to the class Graffiti Wall.

> **For students who are EL, have disabilities, or perform well below grade-level:**
> - Students may need assistance identifying the independent and dependent variables in each situation. Provide these students with notes on determining independent and dependent variables.

Activity 2: Comparing Tables and Graphs

Distribute **Handout 3.2: Comparing Tables and Graphs**. Have students work with their team to answer the situations provided.

- ✓ Actively monitor team progress while students determine if the situation is proportional, create a table from the situation, compare a table to a graph to determine who gets paid more, and identify unit rates (SMP.1).

Note: In this problem, students deal with money. They need a strong sense of rounding to get the precise amounts. They also need to be able to find a unit rate using multiple representations of proportionality.

> **For students who are EL, have disabilities, or perform well below grade-level:**
> - Allow students to use the Desmos Graphing Calculator to create the graphs if needed.
> - Provide students with a multiplication fact sheet to assist in finding unit rates.
>
> **Extensions for students with high interest or working above grade level:**
> - Have students create a situation for a third trainer who makes more than Regina, but less than Hai. Instruct them to represent the third trainer using an equation, table, and graph.

Activity 3: (1, y) Turn and Talk
Provide **Handout 3.3: The Importance of (1, y)** for students to complete independently. After students complete independently, instruct students to Turn and Talk about the discussion question on the handout. Actively monitor discussions and listen for an understanding of (1, y) identifying the unit rate.

Facilitate whole group discussion on (1, y) using the following prompting questions:
- What is (1, y) referring to?
- Can you show me the unit rate on the graph?
- Can you use other points to determine the unit rate? How?
- How did you use the information in the scenario to identify the unit rate?

Activity 4: Connecting the Representations
Direct students to refer to the equations they wrote for tables in the previous lesson. Ask students to identify what the equation has in common with the unit rate (constant of proportionality). Validate student understanding that the value of the unit rate is the same value being multiplied to the x-value (SMP.8). Reinforce the notion of constant of proportionality and unit rate are the same

value and how equations for proportional relationships are written in the form $y = kx$, where k represents the constant of proportionality. Ask students to reflect and share on how the equation $y = kx$ satisfies the characteristics of proportionality.

Display the problem below for students to complete:

T: "Alexia wrote the equation $d = \frac{5}{6}w$ to represent the amount of a bottle of water (w) she consumes in any number of days (d)."

Allow students time to write down important information and ask clarifying questions as needed.

T: "How much water does Alexia drink in 3 weeks?"

Copy the following table on the board:

Alexia's Brother		
Time (days)	3	6
Bottle of Water (#)	2.7	5.4

T: "Alexia's brother kept track of his water consumed in the table. Who drinks more water, Alexia or her brother?"

✓ Monitor students and check for understanding using the following prompting questions:
  - How do you know Alexia's unit rate?
  - How did you calculate Alexia's brother's unit rate?
  - Whose rate is easier to determine?
  - Can you write an equation for Alexia's brother?
  - Can you make a table for Alexia?
  - How would you graph these?
  - What is the y-intercept?
  - Are these relationships proportional? How do you know?

Reflection and Closing:
Select volunteers to share their answers from Activity 4 to close the day's lesson. Facilitate the discussion to center around comparing two different representations of proportional relationships using the following prompting questions:

- How were you able to compare a table and an equation?
- How would you compare a graph to a table or equation?
- What can you conclude about proportional relationships?
- How are the different representations compared?

Homework

Students will create 3 proportional relationships. One must be a table, one a graph, and one an equation.

Handout 3.1: Characteristics of Proportionality

Name: _____   Date: _____

Independent Work:

1. Directions: Make a table to represent each of the situations below.
    a. Angelina is washing dishes at work. She can wash 15 cups in 10 minutes. How many cups can she clean in different amounts of time?
    b. Miles' cat, Cinnamon, weighed 12 ounces at birth. Cinnamon doubled her weight in 6 days. Assuming her growth is constant, how much will Cinnamon weigh at various times in the first year?
    c. Suleiman's bank advertises that it will double your money invested every year. If Suleiman invests the $20 his father gave him for his birthday, how much money will he have in various years?

Group Discussion Questions:

2. Which of the situations above describe proportional relationships?

3. How do you know by looking at the table?

4. Do you think looking at a graph instead of a table would make this easier to determine? Why or why not?

1. Directions: Make a table to represent each of the situations below.
    a. Angelina is washing dishes at work. She can wash 15 cups in 10 minutes. How many cups can she clean in different amounts of time?

Time (minutes)	0	10	20	30	50
Number of Cups Washed	0	15	30	45	60

    b. Miles' cat, Cinnamon, weighed 12 ounces at birth. Cinnamon doubled her weight in 6 days. Assuming her growth is constant, how much will Cinnamon weigh at various times in the first year?

Time (Days Since Birth)	0	6	12	18	24
Weight (ounces)	12	24	36	48	60

Expect students to struggle with (0, 12). Ask provoking questions about something being born and its weight at the time.

    c. Suleiman's bank advertises that it will double your money invested every year. If Suleiman invests the $20 his father gave him for his birthday, how much money will he have in various years?

Time (Years)	0	1	2	3	4
Money	20	40	80	160	320

Students may struggle with (0, 20). Ask students if Suleiman does not invest his money, how much will he have? His money does not disappear if he doesn't invest it with his bank. Also, look for students who add $20 every time instead of doubling the previous amount.

Group Discussion Questions:

2. Which of the situations above describe proportional relationships?

"A" Is the only proportional relationship above. Angelina washes at a rate of 15 cups/10 mins (unit rate of 1.5 cups/minute)

3. How do you know by looking at the table?

"B" cannot be proportional because the cat's starting weight is (0, 12), which means it will not pass through the origin. "C" also does not pass through the origin, nor does it have a constant of proportionality, since every 1 year is growing by a different amount.

4. Do you think looking at a graph instead of a table would make this easier to determine? Why or why not?
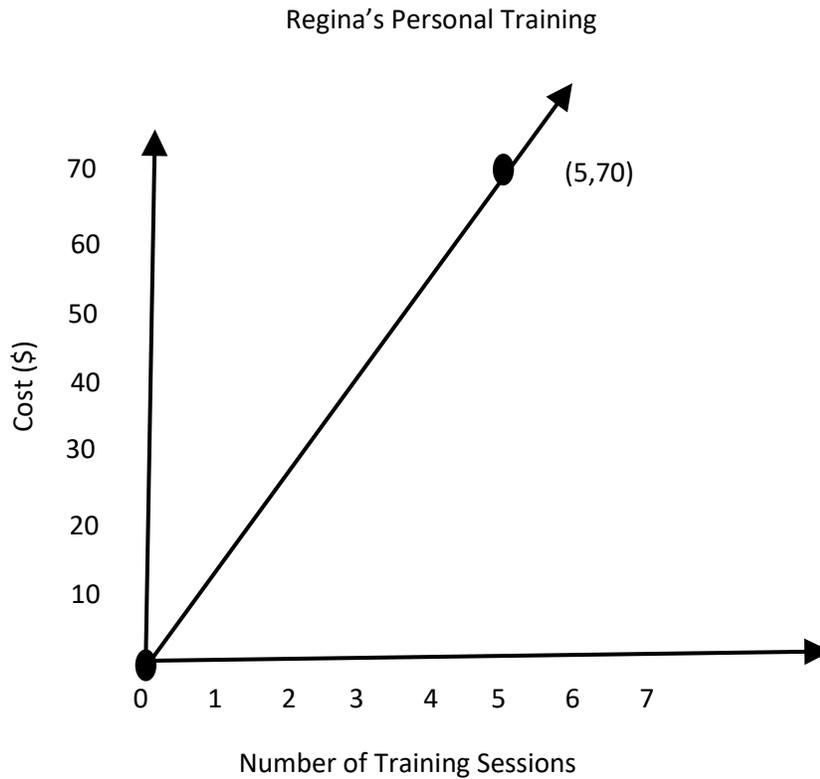
Answers will vary. Use responses to guide teacher questioning in Activity #2.

Handout 3.2: Comparing Tables to Graphs

Name: _____ Date: _____

1. Hai regularly trains a client at his gym. Last month, Hai's client paid him $125 for 8 sessions of training.
   a. Is this situation most likely a proportional relationship? How do you know?

   b. Make a table that shows how much Hai earns for various numbers of training sessions.

   c. Regina brags that she is paid more than Hai to train her client. Regina is paid according to the graph below. Who is paid more? How do you know?

Regina's Personal Training

(5,70)

Cost ($)

Number of Training Sessions

   d. At what unit rate do Hai and Regina each get paid? How do you know? Remember that unit rate compares the change in one quantity to a one-unit change in another quantity, so in this case you would compare dollars to one hour.

1. Hai regularly trains a client at his gym. Last month, Hai's client paid him $125 for 8 sessions of training.

   a. Is this situation most likely a proportional relationship? How do you know?
      Yes, Hai would get paid $0 for 0 training sessions and he's getting paid the same amount for every training session.

   b. Make a table that shows how much Hai earns for various numbers of training sessions.

Number of Training Sessions	0	4	8	12	16
Cost for Client ($)	0	62.50	125.00	187.50	250.00

Students may choose whatever number of sessions they want with, as long as they follow the rule y=15.625x. Because this is money, students need to round to the hundredths place on their table.

   c. Regina brags that she is paid more than Hai to train her client. Regina is paid according to the graph below. Who is paid more? How do you know?

   Hai is getting paid more. Hai is making $15.63/training session and Regina is making $14.00/training session. I know this because … student answers will vary.

   d. At what unit rate do Hai and Regina each get paid? How do you know? Remember that unit rate compares the change in one quantity to a one-unit change in another quantity, so in this case you would compare dollars to one hour.

   Hai: $15.63/session; Regina: $14.00/session. Reasons will vary.

Handout 3.3: The Importance of (1, y)

Name: _____ Date: _____

Nadia's pet dog eats so much that Nadia buys dog food in bulk. Twenty-five pounds of dog food costs $15.75 and fifty pounds of food costs $31.50.

Individual Task:

1. Make a graph of the cost of dog food for various sizes of bags. Be sure your graph includes a title, labels, and an appropriate scale.

2. Calculate the value of y at the point $(1, y)$. Why would Nadia want to know the value of y?

Pair-Share Discussion Topics:

Compare the graphs you and your partner made for the situation above. Did you use the same scale or different scales?

Compare your value of y. Did you get the same value? Explain to your partner what method you used to find the value of y. What does that value tell Nadia?

Nadia's pet dog eats so much that Nadia has to buy dog food in bulk. Twenty-five pounds of dog food costs $15.75 and fifty pounds of food costs $31.50.

Individual Task:

1. Make a graph of the cost of dog food for various sizes of bags. Be sure your graph includes a title, labels, and an appropriate scale.
   Graphs should be linear following the rule y = 0.63x.

2. Calculate the value of *y* at the point (1, *y*). Why would Nadia want to know the value of y?

   The value of y is 0.63. Nadia would want to know this because it tells her that for every 1 pound of dog food she buys she will pay $0.63.

For training or questions regarding this unit,
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