Direct Variation

Strand: Functions

Topic: Determining direct variation

Primary SOL: A.8 The student, given a data set or practical situation, will analyze a relation to determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.

Related SOL: A.1, A.4, A.6, 7.10

Materials

- Graphing calculators (optional)

Vocabulary

dependent variable, independent variable proportion, rate, ratio, slope (A.6)*, y-intercept* (A.7)

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Display the following problem: "A low-flow shower head uses 5 gallons of water every 2 minutes." Ask students to fill in the table representing this situation.

x (minutes)	2	4	6	8
y (gallons)	5			

2. Ask, *"How many gallons would the shower head use in 15 minutes?"* Ask students to find the solution to this problem and to be prepared to explain how they arrived at their solution. Ask students to share their strategies for solving the problem. Record their ideas for the class to see. Strategies may include setting up proportions, finding unit rates, using an equation, and others. Record all strategies shared. *Note: Relate SOL 7.10 back to this table and have students identify the pattern as shown below.*

2 2 2

x (minutes)	2	4	6	8
y (gallons)	5	10	15	20

5 5 5

3. Prompt students to think about how they could represent this situation in a graph, and solicit their ideas. Guide discussion by asking the following questions:
   - What variables are involved?
   - What is the independent variable?
   - What is the dependent variable?
   - What amount of water would be used for zero minutes?
   - Is there a constant slope?
   - What does the slope represent in this problem?
4. Ask students to devise an equation for the situation, if they have not already done so.

5. Next, ask:
    - What is the slope in the equation?
    - What is the y-intercept?
    - What do the slope and y-intercept represent in the problem?

   You may want to have students use their graphing calculators to view this graph.
6. Tell the class that they have just investigated a *direct variation*, which is a relationship in which two variables are directly proportional. In other words, the ratio between the two variables in a direct variation is constant. A direct-variation relationship can be represented with an equation of the form $y = kx$, where k is the constant of variation. Because a direct variation is a proportional relationship, using an equation is an alternate strategy for solving a proportion.

Assessment

- **Questions**
    - How can you tell whether a situation represents a direct variation?
    - What does an equation for a direct variation look like?
    - What does a graph of the equation for a direct variation look like?
- **Journal/Writing Prompts**
    - Give your own example of a direct variation, and explain why your example meets the criteria for a direct variation.
    - Explain how you could determine whether a given table of values represents a direct variation.
    - Explain how you could create an equation to represent a direct variation, given a table of values representing it.

Extensions and Connections (for all students)

- Have students explore the graphs of direct variations, using graphing calculators.
- In this lesson, students experienced a direct variation situation in which only values in the first quadrant make sense. Prompt students to think about a direct variation situation in which values in the third quadrant would be reasonable. Also, prompt students to think of a direct variation situation having a negative slope.

Strategies for Differentiation

- Use a picture of a shower head.
- Have students create a folded graphic organizer with the characteristics of a direct variation and how these characteristics appear in each of the representations—table, graph, and equation. Include examples and non-examples.
- Have students find a pattern for each table as shown in the teacher-led example above.
- Instead of writing the journal prompts, have students share their answers aloud.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Drawing Connections with Direct Variation

Name ________________________________ **Date**______________________

1. Matthew earns $22.50 per hour for working at the gym. This situation can be described by completing the table below.
   a.

x (hours)	1	3	7		16	
y (dollars)	22.50			270		495

   b. Write an equation to represent the table above.
   c. Does this situation represent direct variation? Why, or why not?

2. Determine whether the following tables represent a direct variation.

a.

x	y
-4	-8
-2	-4
6	18

b.

x	y
-5	-4
2	10
4	5

c.

x	y
-3	-12
6	24
8	32

3. Determine whether the following scenarios represent a direct variation.
   a. Green Cab Company charges a flat fee of $5.50 and an additional $1.20 per minute.
   b. Jordan runs 1 mile every 7 minutes.
   c. It takes 4 painters 8 hours to paint a house and 12 painters 6 hours to a paint the same house.

4. Select all of the following that represent direct variation.

y = 5x	3 = *xy*	$y = \frac{2}{x}$
y = 2x + 1	$b = \frac{1}{2}a$	m = 5n