Math Objectives

- Students will identify the domain and range of a relation from the graph.
- Students will write symbolic expressions to describe the domain and range of a function.
- Students will recognize that different functions can have the same domain or the same range.
- Students will look for and make use of structure (CCSS Mathematical Practices).
- Students will use appropriate tools strategically (CCSS Mathematical Practices).

Vocabulary

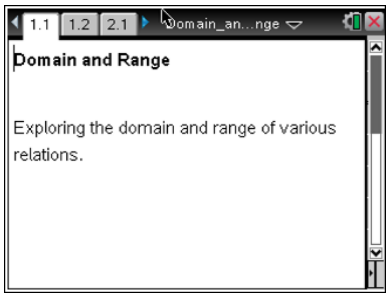
- domain
- range

About the Lesson

- This lesson involves identifying a set of *x*-values in both symbols and words, identifying the set of *x*-values used in generating the function as the domain of the function, and identifying the set of *y*-values used in generating the function as the range of the function.
- As a result, students will:
  - Interpret graphs of functions to identify the domain and the range.
  - Describe sets of *x*-values and *y*-values in both symbols and words.

TI-Nspire™ Navigator™ System

- Use Screen Capture and Live Presenter to demonstrate the process and discuss solutions.
- Use Quick Polls to assess students' understanding.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire handheld is set to Medium.
- You can hide or show the function entry line by pressing ctrl G.

Lesson Materials:

Student Activity
Domain_and_Range_Student.pdf
Domain_and_Range_Student.doc

TI-Nspire document
Domain_and_Range.tns

- Use Teacher Edition computer software to review student documents.

Discussion Points and Possible Answers:

Tech Tip: Grab and move point P to each point on the scatter plot. The coordinates of each point are displayed in the top left corner.

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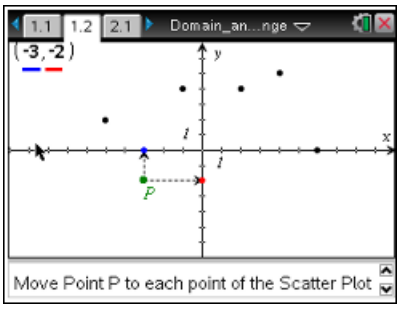
You may use *Screen Capture* or *Live Presenter* to demonstrate how students move from point to point in page 1.3 and how to grab and move point *P* in pages 2.2, 3.2, and 4.2. The entire graph must be covered to get a complete graph of the domain and range.

Move to page 1.2.



1. Grab and move point P to each point on the scatter plot. As you move from point to point, record the coordinates in the table.

   Sample Answer: (The ordered pairs may be listed in a different order.)

Domain	Range
x	*y*
–3	–2
6	0
4	5
2	4
–5	2
–1	4

List the domain:

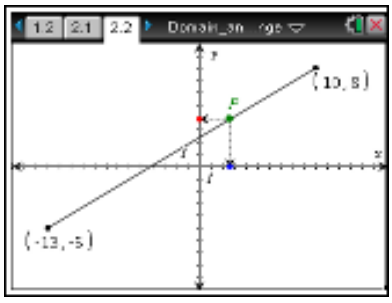
Answer: {–5, –3, –1, 2, 4, 6}

List the range:

Answer: {–2, 0, 2, 4, 5}

Teacher Tip: The values for the domain and range should be listed in order from least to greatest, and should not be repeated.

Move to page 2.2.



2. Grab and move point *P* back and forth along the entire line segment.

   a. What does the highlighted portion along the *x*-axis represent?

      Answer: The highlight along the *x*-axis corresponds to all of the *x*-values included in the ordered pairs of the graph. It **r**epresents the domain of the function.

b. What does the highlighted portion along the *y*-axis represent?

Answer: The highlight along the *y*-axis corresponds to all of the *y*-values included in the ordered pairs of the graph. It represents the range of the function.

c. The set of all possible *x*-values for a relation is called the **domain** of the relation. Describe the domain of the function in the graph. Explain your reasoning.

Answer: Domain: $-13 \leq x \leq 10$. Translate the inequality into words.

Domain: –13 is less than or equal to *x*, which is less than or equal to 10; or all real numbers between –13 and 10, including –13 and 10.

Teacher Tip: In parts b and c, make sure students specify that the endpoints are included.

d. The set of all possible *y*-values for a function is called the **range** of that function. Describe the range of the function in the graph. Explain your reasoning.

Answer: Range: $-5 \leq y \leq 8$. Translate the inequality into words.

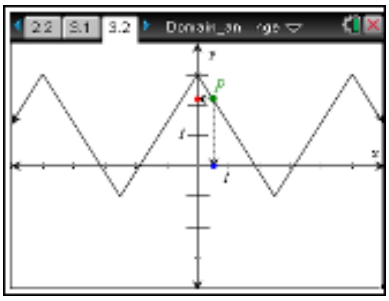
Range: –5 is less than or equal to *y*, which is less than or equal to 8; or all real numbers between –5 and 8, including –5 and 8.

e. If the endpoints of the line segment were open circles, how would the domain and the range change?

Answer: The domain and range would *exclude* the endpoints.

Teacher Tip: This is a discussion point. Emphasize what open/closed circles really mean on a graph, in words, and in an inequality. The endpoint may or may not be part of the domain and range. In this problem, if the circles were open, the inequality symbols would be strictly less than, NOT less than or equal to.

Move to page 3.2.



3. Grab point *P* and move it along the graph.

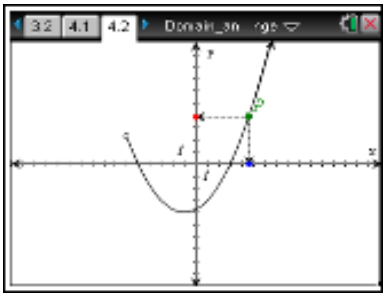
   a. Identify the domain using an inequality and using words.

      Answer: Inequality: $-\infty < x < \infty$
      Words: The domain is all real numbers.

   b. Identify the range using an inequality and using words.

      Answer: Inequality: $-1 \leq y \leq 3$
      Words: The range is all real numbers between –1 and 3, including –1 and 3.

Move to page 4.2.



4. Grab point *P* and move it along the graph.

   a. Identify the domain using an inequality and using words.

      Answer: Inequality: $x > -6$
      Words: The domain is all real numbers greater than –6.

   b. Identify the range using an inequality and using words.

      Answer: Inequality: $y \geq -4$
      Words: The range is all real numbers greater than or equal to –4.

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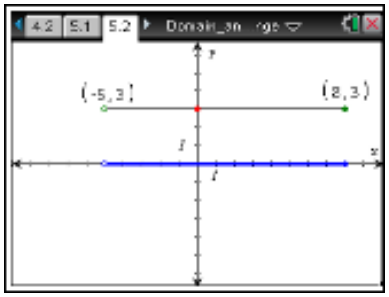
You may use *Screen Capture* or *Live Presenter* for question 5 to identify different approaches to the problem and focus students' attention on identifying the coordinates of the endpoints, as well as which one has to be open and which one closed.

Move to page 5.2.



5. Grab and move the endpoints of the line segment to satisfy each of the following conditions.

   a. The open endpoint is (–3, –5) and the closed endpoint is (5, 4). Identify the domain and range using inequalities and using words.

      Answer: Domain: $-3 < x \leq 5$; all real numbers between –3 and 5, including 5.
      Range: $-5 < y \leq 4$; all real numbers between –5 and 4, including 4.

   b. The domain is between –2 and 1, including 1, and the range is between –6 and 5, including –6. Write the domain and range as inequalities. Identify the endpoints of the line segment, and indicate which endpoint is open.

      Answer: Domain: $-2 < x \leq 1$; Range: $-6 \leq y < 5$; Endpoints: open at (–2, 5) and closed at (1, –6).

   c. The domain is $-3 < x \leq 6$ and the range is $y = 3$. Identify the endpoints of the line segment, and indicate which endpoint is open.

      Answer: The domain is all real numbers between –3 and 6, including 6. The range is 3. The endpoints of the segment are (–3, 3) and (6, 3) with the open endpoint at (–3, 3) and the closed endpoint at (6, 3).

   d. The domain is $x = 6$ and the range is $-5 < y \leq 3$. Identify the endpoints of the line segment, and indicate which endpoint is open.

      Answer: The endpoints of the segment are (6, –5) and (6, 3) with the open endpoint at (6, –5) and closed endpoint at (6, 3).

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You may use *Quick Polls* to assess students' understanding of the lesson. Sample questions like the following may be used.

1. What indicates that the domain or range continues to positive infinity?
   a. The inequality symbol is > or ≥.
   b. There is an arrowhead on the end of the graph pointing to the right or up.
   c. The inequality statement is a simple inequality, not a compound inequality.
   d. All of the above.

2. A linear segment has a given domain $-3 < x \leq 5$ and range $2 \leq y < 7$. The endpoints of the segment are
   a. (–3, 5) open and (2, 7) closed
   b. (–3, 7) closed and (5, 2) open
   c. (–3, 7) open and (5, 2) closed
   d. (–3, 2) open and (5, 7) closed
   e. (–3, 2) closed and (5, 7) open

3. The domain and range must always be equal in size. TRUE or FALSE

Wrap Up

Upon completion of the discussion, the teacher should ensure that students understand:

- How to identify the domain and range from the graph of a relation.
- How to write and interpret symbolic expressions describing the domain and range.
- Different functions can have the same domain or the same range.