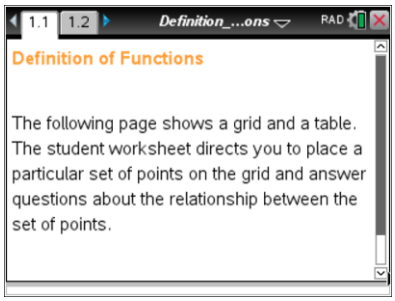
Definition of Functions

MATH NSPIRED

TEACHER NOTES

Math Objectives

- Students will determine the domain and range of relationships given as a set of ordered pairs.
- Students will determine whether or not a relationship is a function or not using the definition.
- Students will verify that relationships are functions or not by examining the relationship graphically and in a table.



Vocabulary

- relationship
- input
- output
- domain
- range
- function

About the Lesson

- This lesson involves examining relationships and functions and their inputs, outputs, domains, and ranges.
- As a result, students will:
  - Examine a relationship, determine its domain and range, and plot it on a coordinate grid.
  - Examine a relationship in table form with arrows to connect inputs with their given outputs.
  - Learn that a function is a rule that assigns to each input exactly one output and that the graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
  - Students will create their own relationships, one that is a function and one that is not.

TI-Nspire™ Navigator™

- Send the .tns file to students.
- Use Class Capture to formally assess students' understanding.
- Use Live Presenter for students to share their thinking.
- Use Quick Poll to assess students' understanding.

Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Definition_of_Functions_Student.pdf
- Definition_of_Functions_Student.doc

TI-Nspire document

- Definition_of_Functions.tns

Discussion Points and Possible Answers

Tech Tip: If students experience difficulty placing points on the graph, check to make sure that they have moved the arrow until it becomes a hand (☜) getting ready to grab the point. Then press ctrl ☜ to grab the point and close the hand (✊).

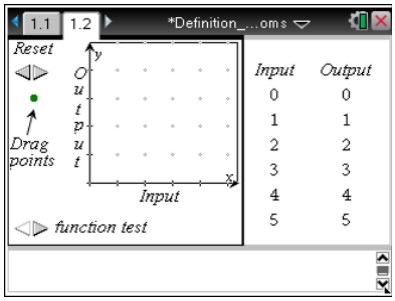
In this activity, you will learn the definitions of relationships and functions. You will create relationships between sets and explore whether or not these relationships are functions.

A ***relationship*** between sets A and B is a collection of ordered pairs in which the first number of the ordered pair is an ***input*** element and a member of set A and the second number of the ordered pair is an ***output*** element and a member to set B. The set of all inputs is called the ***domain,*** and the set of all outputs is called the ***range***.

In this activity, sets A and B will both be equal to the set $\{0, 1, 2, 3, 4, 5\}$.

A ***function*** is defined as a relationship between two sets of numbers where each member of the domain is paired with only one member of the range.

Move to page 1.2.

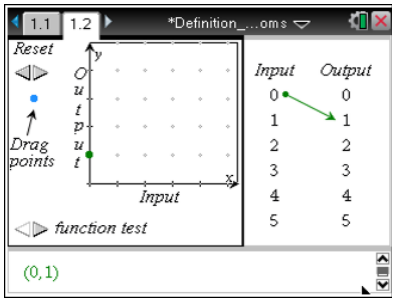


1. A relationship R is defined as $\{(0,1),(1,2),(2,4),(3,3),(4,5)\}$. On page 1.2, plot the first ordered pair of this relationship by dragging a point onto the grid at the location for that point.
   a. How do you know that you plotted the point correctly?

      Answer: The ordered pair shows up in the lower part of the screen.

   b. Describe what the arrow in the table represents.

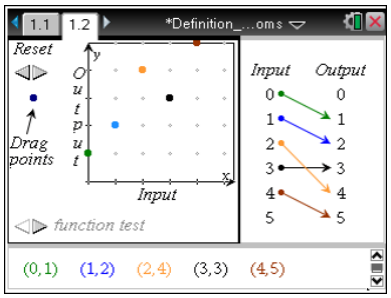
      Answer: The arrow shows the connection between the input and the output.



Teacher Tip: Be sure that students are paying attention to the table at the right hand side of the screen as they move the points onto the grid.

TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 1 at the end of this lesson.

2. Plot the remaining points of the relationship.
   a. List the domain and range of this relationship.



   Answer: The domain is $\{0,1,2,3,4\}$, and the range is $\{1,2,3,4,5\}$.

   b. Does this relationship meet the definition of a function? Why or why not?

   Answer: This relationship is a function because each element of the domain is paired with only one element of the range.

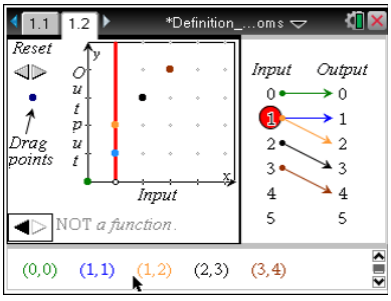
TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 2 at the end of this lesson.

3. Use the arrow for "function test" to determine if your answer to problem 2b was correct. If it was correct, how do these representations help you solidify your understanding of the definition? If you were incorrect, how can these representations help you correct your misunderstandings?

   Sample Answers: The graph shows only one point for each *x*-value, and the table shows only one arrow coming from each input.

TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 3 at the end of this lesson.

4. On Page 1.2, use the arrow for reset. Define a new relationship S as $\{(0,0),(1,1),(1,2),(2,3),(3,4)\}$.
   a. What is the domain and range of this relationship?



   Answer: The domain is $\{0,1,2,3\}$, and the range is $\{0,1,2,3,4\}$.

b. Is this relationship a function? Why or why not?

Answer: It is not a function. 1 maps to 1 and 1 maps to 2.

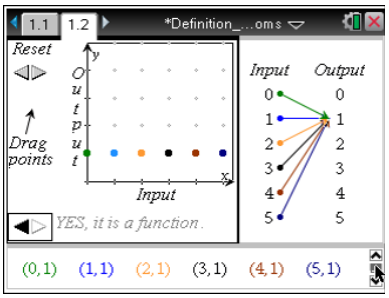
c. Plot these ordered pairs, and test whether or not it is a function. Do the graph, table, and test support your answer to 4b? Why or why not?

Sample Answers: The graph shows a line going through the two points (1,1) and (1,2). The table circles the input of 1. The test states that it is not a function.

Teacher Tip: This might be a good point to introduce the vertical line test for functions.

TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 4 at the end of this lesson.

5. Select the arrow for reset. Define a new relationship T as $\{(0,1),(1,1),(2,1),(3,1),(4,1),(5,1)\}$.



a. What is the domain and range of this relationship?

Answer: The domain is $\{0,1,2,3,4,5\}$, and the range is $\{1\}$.

b. Joey says that T is not a function because the number 1 shows up more than once in range. Is Joey correct? Why or why not?

Answer: Joey is not correct. This relationship is a function because each element of the domain is paired with only one element of the range. It does not matter that they all map to the same element of the range.

Teacher Tip: Students may not use the handheld to answer this question. Also, it might be a good time to define a constant function.

TI-Nspire Navigator Opportunity: *Quick Poll or Live Presenter*
See Note 5 at the end of this lesson.

6. It is your turn to define a new relationship.
   a. Create a relationship between sets A and B that is a function. What is the domain and range of this relationship? Share it with a partner. Have them check that your relationship is a function and verify it using page 1.2. Did you successfully create a relationship that is a function? If not, how could you fix it?

      Sample Answer: Student answers will vary.

   b. Create a relationship between sets A and B that is NOT a function. What is the domain and range of this relationship? Share it with a partner. Have them check that your relationship is not a function and verify it using page 1.2. Did you successfully create a relationship that is not a function? If not, how could you fix it?

      Sample Answer: Students answers will vary.

TI-Nspire Navigator Opportunity: *Live Presenter, or Class Capture*
See Note 6 at the end of this lesson.

Wrap Up

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

- A relationship between two sets is a set of ordered pairs.
- The domain consists of the elements of the first set and constitute the first coordinates in the ordered pairs.
- The range consists of elements of the second set and constitute the second coordinates in the ordered pairs.
- Some relationships are functions and some are not depending on whether or not each element of the domain is assigned to only one element of the range.

TI-Nspire Navigator

Note 1

Question 1 Quick Poll (*Open Response*): Send an Open Response Quick Poll, asking students to submit their answer to question 1.

Note 2

Question 2 Quick Poll (*Open Response*): Send an Open Response Quick Poll, asking students to submit their answer to question 2.

Note 3

Question 3 Quick Poll (*Open Response*): Send an Open Response Quick Poll, asking students to submit their answer to question 3.

Note 4

Question 4 Quick Poll (*Open Response*): Send an Open Response Quick Poll, asking students to submit their answer to the algebraic portion of question 4.

Note 5

Question 5 Quick Poll: Send an Open Response Quick Poll, asking students to submit their answer to the algebraic portion of question 5.

Question 5 Live Presenter: Allow students who graphed the relationship to explain using the graph, table, or function test why Joey is incorrect.

Note 6

Question 6 Live Presenter: Allow students to share their relationships with the whole class.

Question 6 Class Capture: Take a Class Capture of students' relationships.