Lesson Title: What is a Function?
Unit Title: Interpreting Functions
Teacher Candidate: Alexandra Smith
Subject and Grade Level: High School Mathematics – Algebra 2

Placement of Lesson in Sequence

This lesson will be the first lesson in the learning progression that focuses on understanding the concept of a function and using function notation. The standards for this learning progression can be found in a cluster of Mathematics Common Core State Standards under the domain titled *Interpreting Functions*. Due to the amount of information in this lesson, the lesson might span over two class periods depending on mathematics abilities of students and number of students in class.

Central Focus and Essential Questions

This learning progression focuses on having students understand the concept of a function and use function notation. In this learning progression students will learn what a function is, about domain and range, how to determine if a graph is a function and how to use function notation to model real world situation as well as evaluate functions for inputs given within their range.

In this lesson students will learn about relations; what a relation is, different ways a relation can be represented, and about the domain and range of relation. Then after the students have an understanding of relation the teacher will introduce them to function; what requirements a relation must meet in order to be a function, and how to use the vertical line test to determine if a relation is a function.

Content Standards

CCSS.Math.Content.HSF-IF.A.1 - Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.

Learning Outcomes	Assessment
Students will be able to determine if a relation is a function or not. Students will be able to identify the domains and range of relations and functions.	In-class observations as well as in-class conversations (student-to-student and student-to-teacher) will serve as formative assessments to ensure students are ready to move on to the next part of the lesson as well as to ensure students are capable of completing the homework. The homework that follows this lesson will assess whether or not students are able to apply the strategies and methods covered in class to successfully meet the learning targets.

Learning Targets	Student Voice
I will be able to determine whether or not a relation can be classified as a function. I will be able to identify the domain and ranges or any given relation or function.	Throughout the lesson students will be given opportunities to talk with classmates and ask questions of the teacher. These opportunities server as the platform for students to express what they have learned so far and what they are still trying to master. Homework is another way the teacher to 'hear'

	student voice. When correcting homework the teacher will be able to see who understands the material and who does not.

Prior Content Knowledge and Pre-Assessment

Since this lesson is introducing the students to a completely new topic area the only prior content knowledge this lesson will depend on it the students' ability to recall basic algebraic properties and operations.
During the class period prior to this lesson teacher will have students complete a short quiz that focuses on sets of number, properties of real numbers, square roots, simplifying algebraic expressions, and properties of exponents. This quiz will let both teacher and students know what areas the students may require some review. After a short review has been given (likely in the form of homework) the students will be ready to move on to the lesson on functions.

Academic Language Demands

Vocabulary & Symbols	Language Functions	Precision, Syntax & Discourse
• Relation • Domain • Range • Function • *f(x)*		**Mathematical Precision:** **Syntax:** By understanding the definitions of relation and function students will be able to analyze relations to determine whether or not they are functions. By understanding the definitions of domain and range students will be able to identify the domain and range of given relations and functions. **Discourse:** Students will be able to explain in words the differences between relations and functions. Students will also be able to explain how to find the domain and range.

Language Target	Language Support	Assessment of Language Target
I will be able to use the correct mathematical language needed to communicate effectively when referencing relations and functions.	To support the students' use of correct language the teacher will cover all vocabulary words throughout the lesson. The teacher will also use language modeling when talking to/with the students so that they will understand how to correctly talk about relations and functions. When speaking with students they teacher will also require the students to speak using the correct mathematical language. If a student does not use the correct	The teacher will listen to students as they converse with their classmates to see if they are using appropriate and correct language. The teacher will also be checking any written work to ensure appropriate and correct language is used in text-based communication. These will both be informal formative assessment.

	language the teacher will correct them and ask them to repeat what they said.	

Lesson Rationale (Connection to previous instruction and Objective Standards)

This lesson serves as an introduction to functions for the students. It is important for students to have a foundation and understanding of functions because there are many Common Core State Standards that depend on the use of functions. One of these standards is the focus of this lesson. This lesson is also important because without the knowledge obtained in this lesson students will have a hard time completing the remaining lessons in this learning progression.

Differentiation, Cultural Responsiveness and/or Accommodation for Individual Differences

Not all of the students in this class are at the same mathematical level. However this is the first lesson of this learning progression, and hopefully one of the first lessons of the academic year, so gap in ability levels can easily accommodated. To do this, students will be given an assessment the class period before this lesson in order to identify their strengths and weaknesses in basic algebraic properties and operations. Students will be given homework to help strengthen any weaknesses which should allow them to complete this and following lessons with more ease. This assessment also lets to teacher know which skills might need a bit of a review when they come up in class.

Materials – Instructional and Technological Needs (attach worksheets used)

- Teacher
  - Whiteboard and Markers
  - *NAGV Foldable* (one for each student)
  - *Function or Not a Function* handout (one for each students)
  - Glue sticks (enough or two or more at teach group of student desks)
  - Scissors (enough or two or more at teach group of student desks)
  - Copy of notes/lesson plan
- Students
  - Notebooks
  - Something to write with
  - Highlighter (optional)
  - Textbook (*Holt McDougal Algebra 2*)

Teaching & Instructional Activities		
Teacher Activity	**Student Activity**	**Purpose**
Before class the teacher must make sure there are at least two pairs of scissors at each group of student desks and put NAGV Foldable on each student desks. Write directions on whiteboard for students to cutout and fold the *NAGV foldable* and cut out all relations on the *Function or Not a Function* handout when they get to their seat.	Follow directions on the whiteboard and cut out and fold their *NAGV Foldable* and cut out all relations on the *Function or Not a Function* handout.	By having students do this when they first come to class it allows students a transition time to start focusing on math class as well as saves times later in the lesson; all foldables and relation cutouts will be ready to use when they are needed. This allows for the lesson to flow smoothly instead of having to break in the lesson to cut these out.
Teacher leads notes.	Students copy the definition of relation into notes from textbook (p. 44).	Introduce students to relations.

Teacher leads students in filling out the *NAGV foldable*.	Students fill out the *NAGV Foldable*.	To allow students to see the multiple representations of relations.
Teacher leads notes. Teacher will instruct students to leave room in there notes for their *NAGV Foldable* as they will be gluing them in later in the class.	Students copy the definitions of domain and range into notes from textbook (p.44). Students copy DIXROY chart of teacher example on whiteboard.	By waiting to glue in the *NAGV Foldable* it allows for class to flow smoothly and help keep students on task. Notes introduce students to domain and range.
Teacher will lead students through completing Example 1 from the textbook (p.44). During this example it is important for the teacher to point out that 2¢ appears twice in the table but is only listed in the set of output values (range) once. This is because when a domain or range is listed each value is only listed once.	Students are to complete Example 1 in their notebooks. At this time students should be sure to ask questions if they do not understand the process to complete Example 1.	This example offers shows student how they will be asked to show their understanding of domain and range.
Following structure of the textbook the teacher should introduce students to functions. Then the teacher should instruct students to go to the next clean page in their notebooks and write the definition of function at the top of the page and then divide the rest of the page into two columns titles *Function* and *Not a Function*.	On the next clean sheet of paper in their notebooks student should copy the definition of a function from the textbook (p.45). Below this definition student should divide the rest of page into two columns, one titles *Function* and the other *Not a Function*.	Introduce students to Functions.
At this time the teacher should direct students back to their *NAGV Foldable*. Looking at each different relation represented have a class discussion about which ones are functions and which ones are not. Teacher could also use this time to have students link of real would situations that are functions or not functions. For example a person to a phone number, not a function because a person could have multiple phone numbers; a person to	Participate in class discussion.	Students are able to see example of relations that are functions and that are not.

height on a given day, function because a person can only be one height at a certain time; a phone number to people; not a function because more than one person can share a phone number.		
Teacher should direct students to work in their groups to determine whether the relations they cut out at the beginning of class are functions or not. While students are working the teacher will walk around to check for understanding, answer any questions and hand out glue sticks.	In their groups students should figure out if the relation they cut out at the beginning of class are functions or not. Then they should glue the relation in the correct column in their notebooks. After this is complete they should glue their *NAGV Foldable* into the space they left for it in the beginning of the notes.	Have students practice determining whether or not a relation is a function.
Teacher leads notes.	Students copy the definition of vertical line test into notes from textbook (p. 46).	Introduce students to the Vertical Line Test
Teacher will lead students through completing Example 3 from the textbook (p.45). During this example it is important for the teacher to emphasize why the vertical line test proves that the graphs are or are not functions.	Students are to complete Example 3 in their notebooks. At this time students should be sure to ask questions if they do not understand the process to complete Example 3.	Students are able to see example of the vertical line test in use.
Teacher assigns homework. p. 47-48 of textbook #'s 1-20	Students start on homework if time permits otherwise they are to complete it elsewhere before the next class period.	To allow students to practice this and show their understanding of functions and their domain and range.

NAGV Foldable

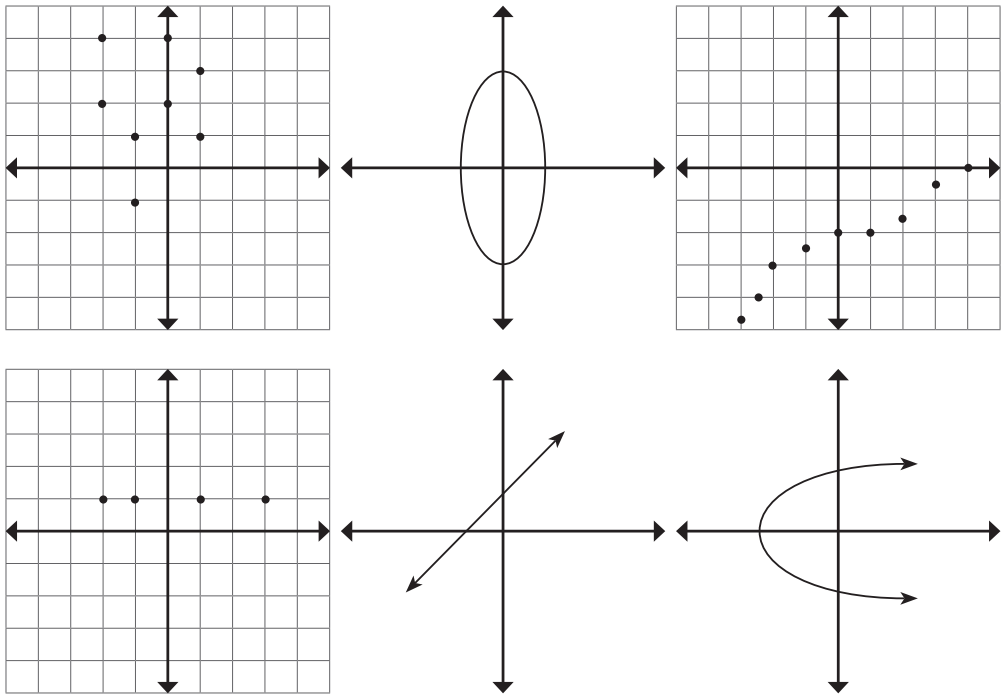
—— Cut Here

- - - - Fold Here

A _____	Glue this section into notebook	Glue this section into notebook	**N** _____
V _____	Glue this section into notebook	Glue this section into notebook	**G** _____

Function or Not a Function?

Directions: Cut out each of the following relations.

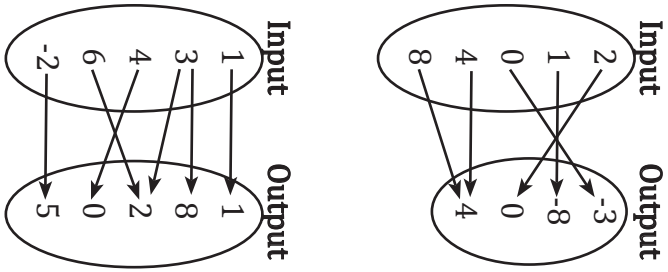


{(-3, 9), (-2, 4), (-1, 1), (0,0), (1,1), (2,4), (3,9)}

{(-1, 3), (2, 8), (-1, 5), (3,15), (2,3), (3,1)}

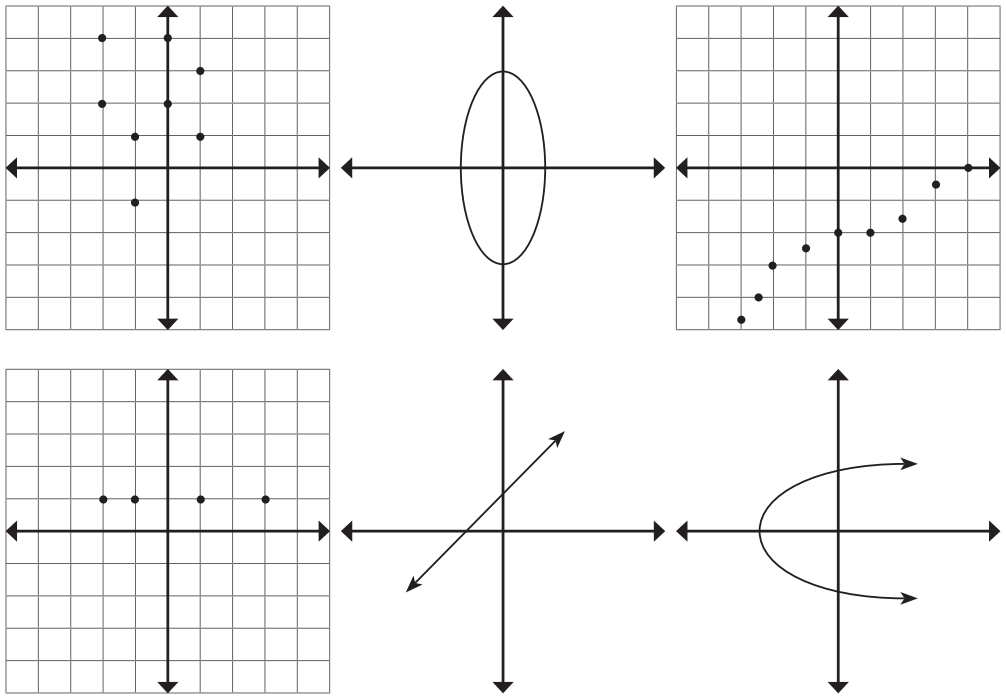
x	y
1	6
2	4
3	2
4	0
5	-2

x	y
-2	0
1	1
3	2
4	6
-2	9



Function or Not a Function?

Directions: Cut out each of the following relations.

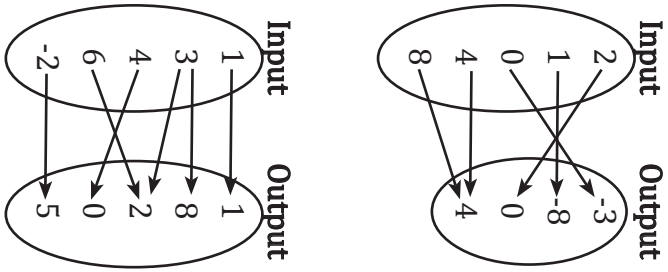


{(-3, 9), (-2, 4), (-1, 1), (0,0), (1,1), (2,4), (3,9)}

{(-1, 3), (2, 8), (-1, 5), (3,15), (2,3), (3,1)}

x	y
1	6
2	4
3	2
4	0
5	-2

x	y
-2	0
1	1
3	2
4	6
-2	9



What is a function?

A relation is a pairing of input values. It can be shown as a set of ordered pairs (x, y), where x is an input and y is an output.

The set of input values is called the **domain**, and the set of output values is called the **range**.

D domain	I input	X x-coord.	R range	O output	Y y-coord.
The Domain of a relation is the set of all Input values or X-coordinates			The Range of a relation is the set of all Output values or Y-coordinates.		

44) **Example 1: Identify Domain & Range**

Give the domain and range for the relation shown.

year	1900	1920	1940	1960	1980	200
rate(¢)	2	2	3	4	15	33

Step 1: List the set of ordered pairs

{(1900, 2), (1920, 2), (1940, 3), (1960, 4) (1980, 15), (2000, 33)}

Step 2: The domain is set of all x-coordinates.

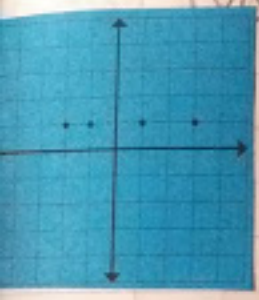
Domain: {1900, 1920, 1940, 1960, 1980, 2000}

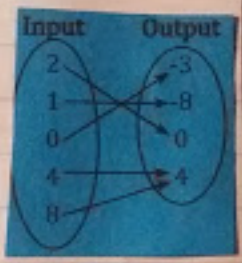
Step 3: The range is the set of all y-coordinates

Range: {2, 3, 4, 15, 33}

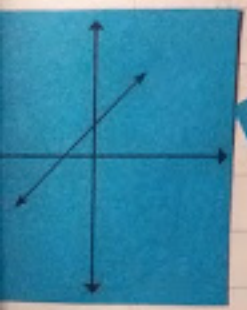
A relation in which the first coordinate is never is called a function. In a function there is only one output for each input, so each element of the domain is mapped exactly one element in the range.

FUNCTION

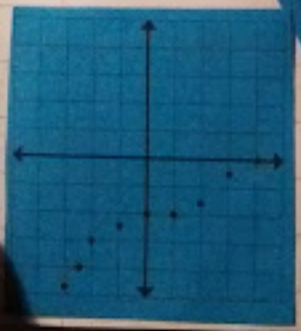




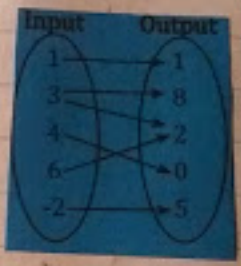
x	y
1	6
2	4
3	2
4	0
5	-2



{(3, 9), (-2, 4), (-1, 1), (0, 0), (1, 1), (2, 4), (3, 9)}



NOT A FUNCTI



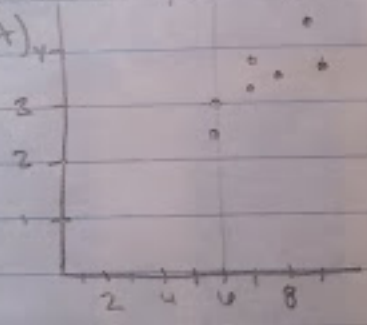
x	y
-2	0
1	1
3	2
4	6
-2	9

{(-1, 3), (2, 8), (-1, 5), (3.15), (2.3), (3.1)}

Vertical Line test:
If any vertical line passes through more than one point on the graph of a relation, the relation is not a function.

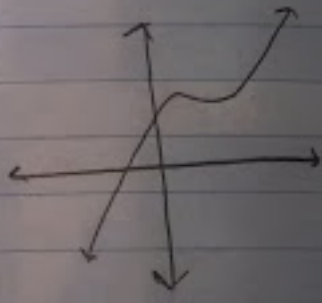
15) Example 3: Using the Vertical Line Test
Use the vertical line test to determine whether each relation is a function. If not, identify two points a vertical line would pass through.

A)



This is not a function because a vertical line at $x=6$ would pass through $(6, 2.5)$ and $(6, 3)$.

B)



This is a function

Homework: p. 47-48 - #'s 1-19

1-6 Exercises

go.hrw.com
Homework Help Online
KEYWORD: MB7 1-6
Parent Resources Online
KEYWORD: MB7 Parent

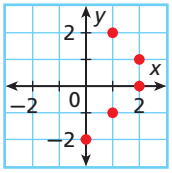
GUIDED PRACTICE

1. **Vocabulary** The set of output values of a function is its __?__. (*domain* or *range*)

SEE EXAMPLE 1 p. 44

Give the domain and range for each relation.

2.



3.

Average Movie Ticket Price	
Year	Price
2000	$5.39
2001	$5.65
2002	$5.80
2003	$6.03

SEE EXAMPLE 2 p. 45

Determine whether each relation is a function.

4.

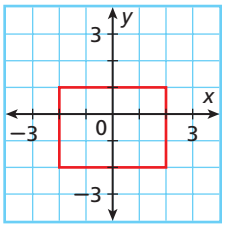
Math Test Scores				
Name	Jan	Helen	Luke	Soren
Score	90	84	88	84

5. from car models to car colors

SEE EXAMPLE 3 p. 46

Use the vertical-line test to determine whether each relation is a function. If not, identify two points a vertical line would pass through.

6.



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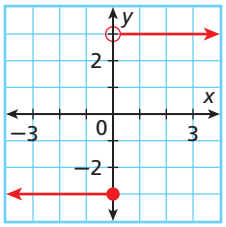
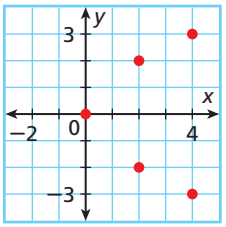


8.



PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
9–10	1
11–12	2
13–15	3

Extra Practice

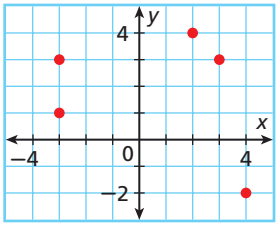
Skills Practice p. S5
Application Practice p. S32

Give the domain and range for each relation.

9.

Basketball Points Scored				
Player	Irene	Anna	Lea	Kate
Points	22	12	16	12

10.

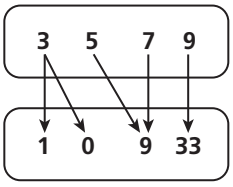


Determine whether each relation is a function.

11.

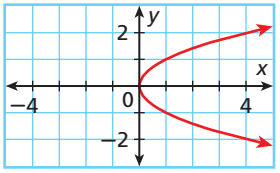
Women's Glove Sizes			
Size	S	M	L
Maximum Hand Length (in.)	6.5	7.5	8.5

12.

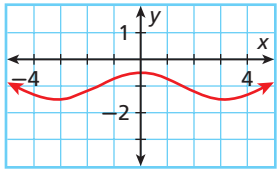


Use the vertical-line test to determine whether each relation is a function. If not, identify two points a vertical line would pass through.

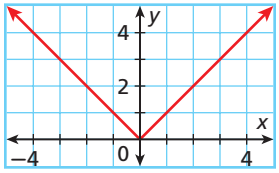
13.



14.



15.

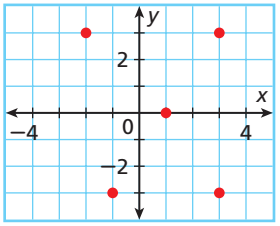


Give the domain and range of each relation and make a mapping diagram.

16. $\{(-5, 0), (0, -5), (5, 0), (0, 5)\}$

17. $\{(-2, -2), (-1, -2), (0, 0), (1, 2), (2, 2)\}$

18.



19.

Average Egg Weights	
Size	**Weight (oz)**
Jumbo	2.5
Extra large	2.25
Large	2
Medium	1.75

20. from each unique letter in the word *seven* to the number that represents the position of that letter in the alphabet

21. **Money** In 1999 the U.S. Mint began releasing quarters to commemorate each of the 50 states. The release schedule specified that each year for a total of 10 years, new quarters commemorating 5 different states would be released. Explain whether each relation is a function.

- **a.** from each year to the number of states with new quarters released in that year
- **b.** from each state to the year its quarter is released
- **c.** from each year to the states with new quarters released in that year
- **d.** from each year to the total number of states with quarters released by the end of that year
- **e.** from the number of new quarters released each year to the year

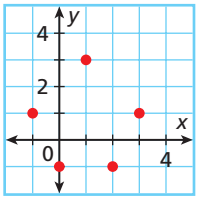
Money

By the end of 2004, there were more than 17.6 billion state quarters in circulation.

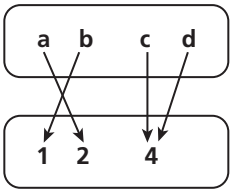
Source: www.usmint.gov

Give the domain and range of each relation. Then explain whether the relation is a function.

22.



23.



24. $\{(7, 1), (7, 2), (7, 3), (7, 4), (7, 6)\}$

25. $\{(9, 3), (7, 3), (5, 3), (3, 3), (1, 3)\}$

26.

x	3	0	0	−1	−3
y	−4	−3	−1	−2	0

27.

x	7	6	5	4	3
y	−1	2	−1	2	3

28. From the months of the year to the number of days in that month in a non-leap year

29. From day of the week to the number of hours in that day