Plan for Algebra 1 Unit 4: Functions

Relevant Unit(s) to review: Grade 8 Unit 5: Functions and Volume

Essential prior concepts to engage with this unit	• Understand the meaning of function as a rule with exactly one output for each allowable input. • Understand independent and dependent variables and how they relate to functions.
Brief narrative of approach	In grade 8, students learned that a function is a rule that assigns exactly one output to each input. In this unit, students expand and deepen their understanding of functions. They are introduced to new tools for communicating about functions including function notation, domain and range, average rates of change, and mathematical terms for describing key features of graphs. The two supplemental lessons offer a brief introduction to the key language used for functions, so that they are ready to focus on function notation when they begin grade-level work. The unit includes an introduction to piecewise functions (Lesson 12), an introduction to absolute value functions (Lessons 13 and 14), as well as an opportunity to revisit content from Unit 2 in solving for variables in the lessons on inverse functions (Lessons 15–17). It was tempting to omit concepts introduced after Lesson 11, because students will revisit these ideas in greater detail in Algebra 2, however they were not omitted, with the idea in mind that exposure to these ideas in Algebra 1 will support deeper understanding in Algebra 2.

Lessons to Add	Lessons to Remove or Modify
1. 8.5.2 2. 8.5.3	1. Combine Lessons 13 and 14, by completing Lesson 14 Activities 3 and 4 outside of class. 2. Lesson 18: Complete outside of class.
Lessons added: 2	Lessons removed: 2

Modified Plan for Algebra 1 Unit 4

Day	IM lesson	Notes
	assessment	Check Your Readiness assessment
1	8.5.2	
2	8.5.3	Analyzing dot plots as visual representations of data
3	A1.4.1	
4	A1.4.2	
5	A1.4.3	
6	A1.4.4	
7	A1.4.5	
8	A1.4.6	
9	A1.4.7	
10	A1.4.8	
11	A1.4.9	
12	assessment	Mid-unit Assessment
13	A1.4.10	
14	A1.4.11	
15	A1.4.12	
16	A1.4.13 A1.4.14	Combine these lessons. Move Lesson 14 Activities 3 and 4 to outside of class.

17	A1.4.15	
18	A1.4.16	
19	A1.4.17	
20	assessment	End-of-unit assessment

Priority and Category List for Lessons

High priority (+), Medium priority (0), Low priority (-)

E: Explore, Play, and Discuss, D: Deep Dive, A: Synthesize and Apply

Lesson	Priority (+, 0, -)	Category (E, D, A)	Notes
A1.4.1	0	E	Recall the meaning of functions.
A1.4.2	+	D	Introduces key vocabulary for functions. Introduces function notation.
A1.4.3	0	D	Provides more practice to consolidate learning on function notation.
A1.4.4	+	A	Applies function notation to equations.
A1.4.5	+	A	Provides more practice with understanding function notation.
A1.4.6	0	E	Connects functions to graphs.
A1.4.7	+	D	Explores average rate of change, which is a key idea in high school math.
A1.4.8	0	D	Sketch graphs given a situation.
A1.4.9	0	A	Compare key features of graphs; introduces key graphing vocabulary.

A1.4.10	+	E	Introduces the concept of domain and range.
A1.4.11	+	D	Dives deeper into concepts of domain and range.
A1.4.12	0	E	Introduces piecewise functions.
A1.4.13	0	D	Introduces absolute value functions.
A1.4.14	+	A	Continues to investigate absolute value function. This is the first lesson in Algebra 1 to explore the behavior of functions, which will be revisited in subsequent units.
A1.4.15	0	E	Introduce inverse functions.
A1.4.16	0	D	Continues learning on inverse functions.
A1.4.17	0	A	Works on writing inverse functions to solve problems.
A1.4.18	0	A	Modeling with functions.

Lesson 2: Introduction to Functions

2.1: Square Me

Here are some numbers in a list:

$$1, -3, -\frac{1}{2}, 3, 2, \frac{1}{4}, 0.5$$

1. How many different numbers are in the list?
2. Make a new list containing the squares of all these numbers.
3. How many different numbers are in the new list?
4. Explain why the two lists do not have the same number of different numbers.

2.2: You Know This, Do You Know That?

Say yes or no for each question. If yes, draw an input-output diagram. If no, give examples of two different outputs that are possible for the same input.

1. A person is 5.5 feet tall. Do you know their height in inches?
2. A number is 5. Do you know its square?

3. The square of a number is 16. Do you know the number?

4. A square has a perimeter of 12 cm. Do you know its area?

5. A rectangle has an area of 16 cm^2. Do you know its length?

6. You are given a number. Do you know the number that is $\frac{1}{5}$ as big?

7. You are given a number. Do you know its reciprocal?

2.3: Using Function Language

Here are the questions from the previous activity. For the ones you said yes to, write a statement like, "The height a rubber ball bounces to depends on the height it was dropped from" or "Bounce height is a **function** of drop height." For all of the ones you said no to, write a statement like, "The day of the week does not determine the temperature that day" or "The temperature that day is not a function of the day of the week."

1. A person is 5.5 feet tall. Do you know their height in inches?

2. A number is 5. Do you know its square?

3. The square of a number is 16. Do you know the number?

4. A square has a perimeter of 12 cm. Do you know its area?

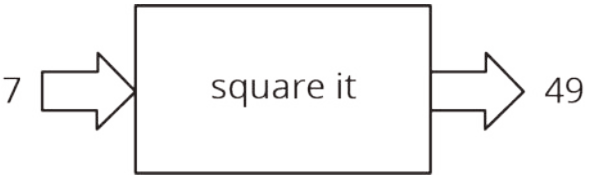
5. A rectangle has an area of 16 cm^2. Do you know its length?

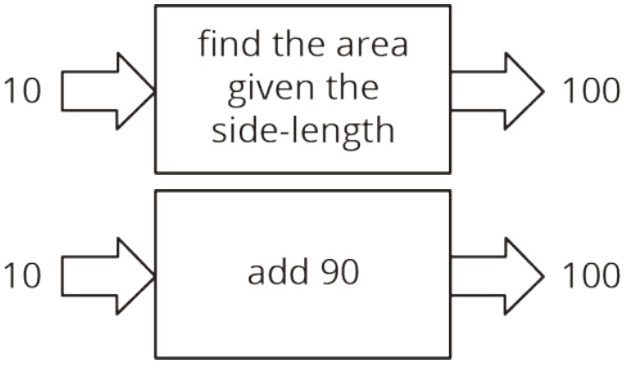
6. You are given a number. Do you know the number that is $\frac{1}{5}$ as big?

7. You are given a number. Do you know its reciprocal?

2.4: Same Function, Different Rule?

Which input-output rules could describe the same function (if any)? Be prepared to explain your reasoning.





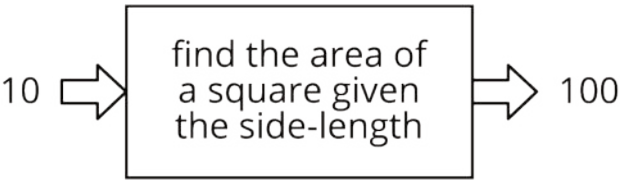
Are you ready for more?

The phrase “is a function of” gets used in non-mathematical speech as well as mathematical speech in sentences like, “The range of foods you like is a function of your upbringing.” What is that sentence trying to convey? Is it the same use of the word “function” as the mathematical one?

Lesson 2 Summary

Let's say we have an input-output rule that for each allowable input gives exactly one output. Then we say the output *depends* on the input, or the output is a **function** of the input.

For example, the area of a square is a function of the side length, because you can find the area from the side length by squaring it. So when the input is 10 cm, the output is 100 cm^2.



Sometimes we might have two different rules that describe the same function. As long as we always get the same, single output from the same input, the rules describe the same function.

Lesson 2: Introduction to Functions

Cool Down: Wait Time

You are told that you will have to wait for 5 hours in a line with a group of other people. Determine whether:

1. You know the number of minutes you have to wait.

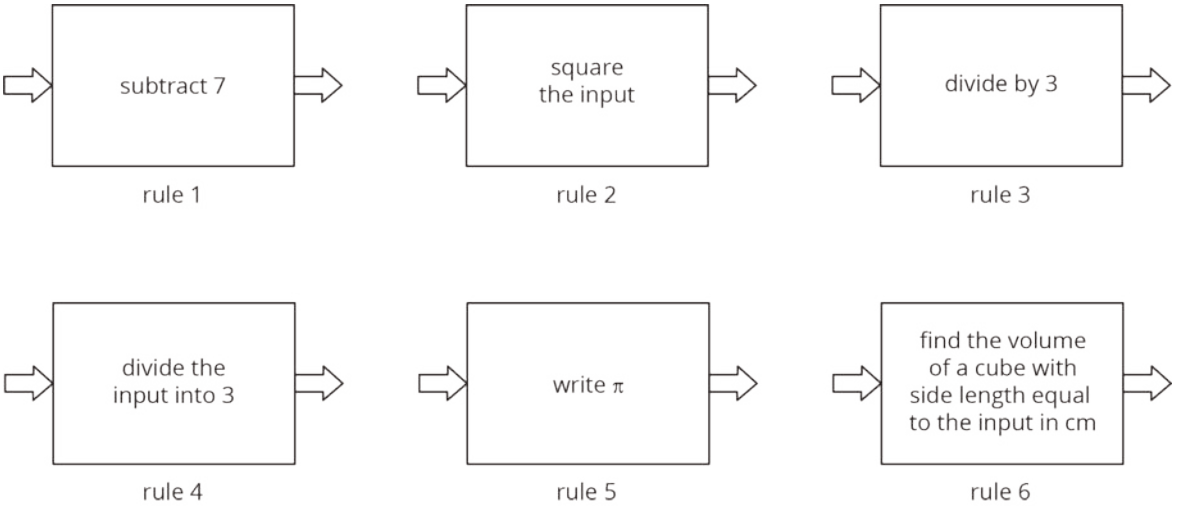
2. You know how many people have to wait.

For each statement, if you answer yes draw an input-output diagram and write a statement that describes the way one quantity depends on another.

If you answer no give an example of 2 outputs that are possible for the same input.

Unit 5 Lesson 2 Cumulative Practice Problems

1. Here are several function rules. Calculate the output for each rule when you use -6 as the input.



2. A group of students is timed while sprinting 100 meters. Each student's speed can be found by dividing 100 m by their time. Is each statement true or false? Explain your reasoning.

   a. Speed is a function of time.

   b. Time is a function of distance.

   c. Speed is a function of number of students racing.

   d. Time is a function of speed.

3. Diego's history teacher writes a test for the class with 26 questions. The test is worth 123 points and has two types of questions: multiple choice worth 3 points each, and essays worth 8 points each. How many essay questions are on the test? Explain or show your reasoning.

(From Unit 4, Lesson 15.)

4. These tables correspond to inputs and outputs. Which of these input and output tables could represent a function rule, and which ones could not? Explain or show your reasoning.

Table A:

input	output
-2	4
-1	1
0	0
1	1
2	4

Table B:

input	output
4	-2
1	-1
0	0
1	1
4	2

Table C:

input	output
1	0
2	0
3	0

Table D:

input	output
0	1
0	2
0	3

Lesson 3: Equations for Functions

3.1: A Square's Area

Fill in the table of input-output pairs for the given rule. Write an algebraic expression for the rule in the box in the diagram.

input	output
8	
2.2	
$12\frac{1}{4}$	
s	

3.2: Diagrams, Equations, and Descriptions

Record your answers to these questions in the table provided.

1. Match each of these descriptions with a diagram:
   a. the circumference, C, of a circle with **radius**, r

   b. the distance in miles, d, that you would travel in t hours if you drive at 60 miles per hour

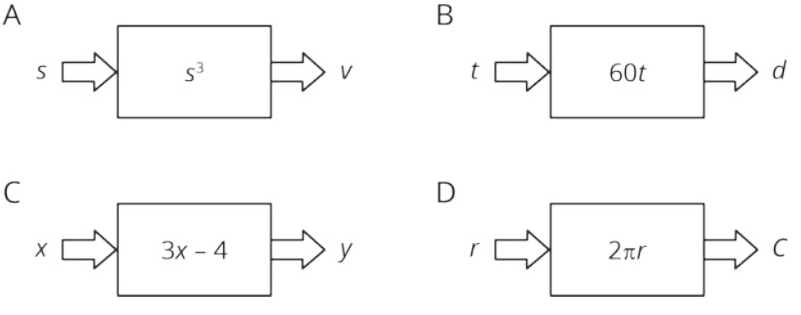
   c. the output when you triple the input and subtract 4

   d. the volume of a cube, v given its edge length, s

2. Write an equation for each description that expresses the output as a function of the input.

3. Find the output when the input is 5 for each equation.

4. Name the **independent** and **dependent variables** of each equation.



description	a	b	c	d
diagram				
equation				
input = 5 output = ?				
independent variable				
dependent variable				

Are you ready for more?

Choose a 3-digit number as an input.

Apply the following rule to it, one step at a time:

- Multiply your number by 7.
- Add one to the result.
- Multiply the result by 11.
- Subtract 5 from the result.
- Multiply the result by 13
- Subtract 78 from the result to get the output.

Can you describe a simpler way to describe this rule? Why does this work?

3.3: Dimes and Quarters

Jada had some dimes and quarters that had a total value of $12.50. The relationship between the number of dimes, d, and the number of quarters, q, can be expressed by the equation $0.1d + 0.25q = 12.5$.

1. If Jada has 4 quarters, how many dimes does she have?

2. If Jada has 10 quarters, how many dimes does she have?

3. Is the number of dimes a function of the number of quarters? If yes, write a rule (that starts with $d =$...) that you can use to determine the output, d, from a given input, q. If no, explain why not.

4. If Jada has 25 dimes, how many quarters does she have?

5. If Jada has 30 dimes, how many quarters does she have?

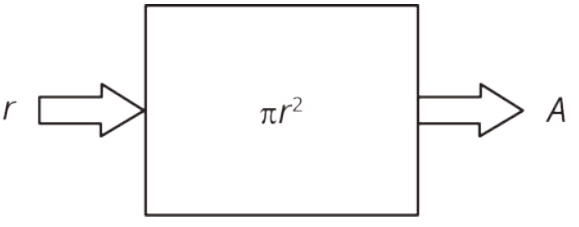
6. Is the number of quarters a function of the number of dimes? If yes, write a rule (that starts with $q =$...) that you can use to determine the output, q, from a given input, d. If no, explain why not.

Lesson 3 Summary

We can sometimes represent functions with equations. For example, the area, A, of a circle is a function of the radius, r, and we can express this with an equation:

$$A = \pi r^2$$

We can also draw a diagram to represent this function:



In this case, we think of the radius, r, as the input, and the area of the circle, A, as the output. For example, if the input is a radius of 10 cm, then the output is an area of 100π cm^2, or about 314 square cm. Because this is a function, we can find the area, A, for any given radius, r.

Since it is the input, we say that r is the **independent variable** and, as the output, A is the **dependent variable**.

Sometimes when we have an equation we get to choose which variable is the independent variable. For example, if we know that

$$10A - 4B = 120$$

then we can think of A as a function of B and write

$$A = 0.4B + 12$$

or we can think of B as a function of A and write

$$B = 2.5A - 30$$

Lesson 3: Equations for Functions

Cool Down: The Value of Some Quarters

The value v of your quarters (in cents) is a function of n, the number of quarters you have.

1. Draw an input-output diagram to represent this function.

2. Write an equation that represents this function.

3. Find the output when the input is 10.

4. Identify the independent and dependent variables.

Unit 5 Lesson 3 Cumulative Practice Problems

1. Here is an equation that represents a function: $72x + 12y = 60$.

   Select **all** the different equations that describe the same function:

   A. $120y + 720x = 600$

   B. $y = 5 - 6x$

   C. $2y + 12x = 10$

   D. $y = 5 + 6x$

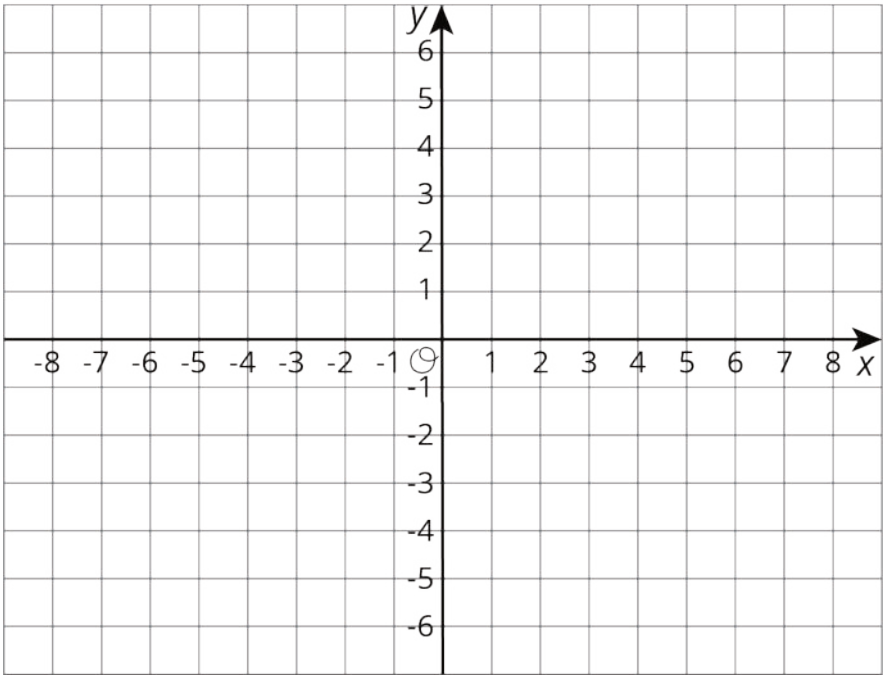
   E. $x = \frac{5}{6} - \frac{y}{6}$

   F. $7x + 2y = 6$

   G. $x = \frac{5}{6} + \frac{y}{6}$

2. a. Graph a system of linear equations with no solutions.

   b. Write an equation for each line you graph.



(From Unit 4, Lesson 13.)

3. Brown rice costs $2 per pound, and beans cost $1.60 per pound. Lin has $10 to spend on these items to make a large meal of beans and rice for a potluck dinner. Let b be the number of pounds of beans Lin buys and r be the number of pounds of rice she buys when she spends all her money on this meal.

   a. Write an equation relating the two variables.

   b. Rearrange the equation so b is the independent variable.

   c. Rearrange the equation so r is the independent variable.

4. Solve each equation and check your answer.

$2x + 4(3 - 2x) = \frac{3(2x+2)}{6} + 4$

$4z + 5 = -3z - 8$

$\frac{1}{2} - \frac{1}{8}q = \frac{q-1}{4}$

(From Unit 4, Lesson 6.)