Name:

IN THIS LESSON, YOU WILL:

- Be able to understand and create an expression in function notation
- Evaluate the domain and range of a function from its constraints
- Represent real world scenarios as a function
- Evaluate functions for a specific input value or set of values
- Understand how to model and calculate different types of taxes

INTRO

ACTIVITY: **PLAY: What's in the Box?**
Follow your teacher's directions to complete this activity.

LEARN IT

What is a Function?
A **function** is a relationship where each input value has only one output value. For example:

$f(x) = x^2$ is a function because no matter what the value of x is, x^2 has only one value

If $f(x)^2 = x$, then $f(x) = \pm\sqrt{x}$ is NOT a function because every x value has TWO values for f(x)

Instead of using lengthy verbal descriptions like you did in the intro activity, you can use an equation to describe what a function will do. **Function notation** is a way to express how the function transforms the input into the output, such as: f(x) = x + 5. This means that this function named "f" operates on the variable "x" and it adds 5 to it. If you put x 'into' this function, f(x) tells you what comes 'out.' A few things to remember about function notation:

- The input can be represented by any variable, though 'x' is used most often unless another variable makes more sense for a particular problem.
- The output is represented as f(x) which reads "the function 'f' of 'x' " or just "f of x" for short.
- The most common letter to define a function is 'f' though any could be used (e.g. g(x), h(x), m(x))

Example 1
Johnny triples his money by investing, and then pays $2 in capital gains taxes when he sells those investments. Write this using function notation where x is the amount of money Johnny starts with.

1	**Represent the steps of the function:** Write the steps in the order they happen in the function using an input variable	1) Start with x 2) Multiply x by 3 3) Subtract 2 from the result
2	**Write an equation for the function:** Using parentheses initially may help keep track of the order of operations	f(x) = (x * 3) - 2 f(x) = 3x - 2

PRACTICE IT

Function Notation

Functions are a perfect way to concisely describe situations and begin to calculate outcomes and make comparisons. Practice writing functions for each of the scenarios below.

1. **Model the function, f, which operates on variable x by adding 2, and then doubling that quantity.**

2. **Jeremiah makes $15 an hour working part-time at a local fast food restaurant. He pays approximately 11% in taxes on his earnings. If h is his hours worked, model his weekly after-tax wages as a function w(h) of hours worked.**

3. **Sarah goes to the grocery store and buys g packs of gum. Sales tax in Connecticut is 6.35%. If a single pack of gum costs $0.89, write a function p(g) to model the scenario.**

4. **Janet rents a booth at the farmers market that costs $150 a day. She sells jars of fresh honey from her family farm for $8 each. At the end of the day, she splits all the money she brings home with her mom who takes care of the bees. If j is the number of jars of honey sold, write a function f(j) representing how much money Janet makes each day.**

📖 LEARN IT

Evaluating Functions
Evaluating functions is the process of finding the output value of a function for a given input value. To do this, substitute the input value for the variable and then simplify the expression.

Example 2
Maritza earns $18 an hour tutoring at the community center. On weekends, she is paid a bonus $15 per shift. How much money would Maritza earn for working 6 hours on a Saturday? If x is the number of hours worked, solve the function f(x) for x = 6 hours.

1	**Express using function notation:**	$f(x) = 15 + 18x$
2	**Substitute for the input variable:**	$f(6) = 15 + 18(6)$
3	**Solve:**	$f(6) = 15 + 18(6)$ $f(6) = 15 + 108$ $f(6) = 123$ She would earn **$123** working 6 hours on Saturday

Domain and Range
The domain and range describe the limits of the function. The **domain** is the set of all the possible input values. The **range** is the set of all the possible output values. You need to know the domain BEFORE you can determine the range.

Example 3
Armando works as a street sign advertiser for a local restaurant. He is paid $10 a shift plus $0.50 for every customer who comes into the restaurant during his shift up to a maximum of $100 per shift. Determine the domain and range of the function that describes Armando's daily wages.

1	**Express using function notation:**	$f(x) = 10 + 0.5x$
2	**Determine the lower and upper bounds of the** <u>**domain:**</u> If no constraints are given by the problem, the solution is the set of all real numbers, ℝ	Lower: The fewest customers that can visit is 0 Upper: There is nothing limiting the number of customers that can visit the restaurant, so there is no upper bound
3	**Determine the lower and upper bounds of the** <u>**range:**</u> Often this comes from the lowest and highest values from the input, but not always!	Lower: The lowest amount Armando can make is $10 if 0 customers visit the restaurant Upper: If enough customers came, then Armando would hit his maximum salary of $100
4	**Express the domain and range as inequalities:** If only one side is bounded you can use a simple inequality	Domain: $x \geq 0$ Range: $10 \leq f(x) \leq 100$

PRACTICE IT

Evaluating Functions, Domain, and Range

Functions can tell us general rules for a situation, while evaluating functions tells us what specific outcomes will result from specific inputs. Practice evaluating functions and identifying domain and range for each of the scenarios below. If no limit is specified, assume that the quantity is not bounded.

1. **Taylor makes $13 per hour at the grocery store. She always works between 10-15 hours per week to leave time for her homework and band practice. Her gross wages can be modeled as w(h) = 13h, where h is the number of hours worked per week.**
   a. How much will her gross wages be if she works 12 hours this week?

   b. What is the domain of this function?

   c. What is the range of this function?

2. **Susan earns 0.5% interest annually in her savings account. She can model her savings account balance after earning interest for a year as f(x) = x + 0.005x, or just f(x) = 1.005x, where x is the account balance.**
   a. What will be her account balance after a year if she started with $30,000 in her account?

   b. What is the domain of this function?

   c. What is the range of this function?

3. **Joan has an employee discount of 15% off at StuffMart. She needs to buy 4 packages of hot dogs and 3 packages of buns for her cookout. A package of hot dogs is $2.50 and the cheapest buns are $0.50, while the most expensive "fancy" buns are $4.50. If b is the cost of a package of buns, she can model her purchase as c(b) = 0.85(3b + 10) or c(b) = (3b +10) - 0.15(3b + 10)**
   a. What would her total purchase price be if buns cost $1.50?

   b. What is the domain of this function?

   c. What is the range of this function?

4. **The function f operates on variable x by tripling it, adding 5, and then doubling that quantity again. This can be modeled as f(x) = 2(3x + 5).**
   a. What would be f(22)?

   b. What would be f(-22)?

   c. What is the domain of this function?

   d. What is the range of this function?

Follow your teacher's directions to complete the Application Problems.

Teachers, you can find the Application problems linked in the Lesson Guide.