**Introduction to Functions**

**Section 1**

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| 00:00:00 | TEACHER: In this lesson, we're answering the lesson question, |
| 00:00:04 | what is a function, and how can I identify one? You reviewed how to create a table from an equation using inputs and outputs. Now let's learn how to identify if an equation like the one you see here is a function based on its input and output values. |

**Section 2**

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| 00:00:01 | TEACHER: Now let's look at identifying functions. |
| 00:00:04 | Let's look at the definition at the bottom of the slide. A function is a relation in which one input is paired with exactly one output. Let's look at the tables for the equations. For each input, is there exactly one output? Well, let's look at the first table here on the left side of the slide. y equals x squared minus 3-- |
| 00:00:24 | let's look at the input output table. For each input, do we have a different output? We do. So it does match the definition. So for each input, we have exactly one output. So y equals x squared minus 3 is an example of a function. Let's look at the right side of the slide. The equation is y squared equals x. |
| 00:00:49 | Let's look at the inputs and the outputs in the table-- 9 to negative 3, 1 to negative 1, 9 to 3, 25 to 5. So it doesn't match up the definition. For one input, is it paired with exactly one output? Well, here we have the same input, 9. And we have two different outputs. So in this case, we have one input, but it's not paired with exactly one output. |
| 00:01:13 | There are two different outputs. So since it doesn't match the definition of what is a function, y squared equals x is not a function. And this is our look at identifying functions. |

**Section 4**

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| 00:00:01 | TEACHER: You now know how to determine whether or not a |
| 00:00:03 | relation is a function based on a table of values. It can be more difficult to look at an equation and determine whether or not it is a function. Making a table for the equation will help you recognize which types of equations are functions. So let's look at these tables of equations and determine whether they're functions or not functions. Let's go ahead and look at the first one. |
| 00:00:25 | We have y squared equals x plus 12. Let's look at the table of values. Remember, by definition a function has exactly one output for each input. Well, here we have the input of negative 3. But there are two different outputs. Also, we have an input of 4 with two different outputs. So this does not follow the definition that there should |
| 00:00:50 | be exactly one output for each input. So this first equation is not a function. Let's look at the second equation, x squared plus y squared equals 9. Let's look at the table of values. Remember for each input, there should be exactly one output. That works-- works down here. |
| 00:01:13 | But here we have two inputs with two different outputs. So once again, this one is not a function. Let's look at the last equation, y equals 3x plus 4. Let's look at the table of values. Remember, the definition, exactly one output for each input. This works there, works all the way through the table. There is exactly one output for each input. |
| 00:01:39 | So this last equation is a function. Now, what do you notice about the equations of the first two that are not functions? Well, you should notice that they both have a y squared as part of the equation. We're going to explore this further on the next slide. Let's look at function and nonfunction equations. Let's look at the left side first. |
| 00:02:01 | These are all examples of functions. What you should notice about these equations is, they all have something in common. They all have y equals somewhere in the equation. So that's what makes these all functions. y is going to equal some number. Let's look at these that are not functions. What do they have in common? |
| 00:02:21 | Well, it's not a function if you have x equals some number, or if you have y squared in the equation. So this is our example of functions versus nonfunction equations. |

**Section 7**

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| 00:00:00 | TEACHER: You've been answering the question, what is a |
| 00:00:03 | function, and how can I identify one? You just learned how to identify a function based on a table or an equation. In this part of the lesson, you'll identify a function based on a graph. |

**Section 8**

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| 00:00:01 | TEACHER: Recall that a function is a function if |
| 00:00:03 | every input has exactly one output. Functions can be determined by looking at a graph. So let's go ahead and look at that more closely. Consider the points in the following table-- negative 3, negative 4, negative 1, 0, and 1, 4. First thing I'm going to do is, plot these points onto the grid. Negative 3, negative 4-- |
| 00:00:24 | there's the first point. Negative 1, 0-- there is the second point. And 1, 4-- there's the third point. Now I'm going to draw a line through the point so we could see what the graph would look like. To identify functions from a graph, we use something called |
| 00:00:37 | the vertical line test. Down here it tells us what is a vertical line test. It states if any vertical line passes through no more than one point, then the relation is a function. Let me go ahead and draw some vertical lines here through our graph that we have on the grid. Let me draw one here. Draw another one here. |
| 00:00:59 | And I'm going to draw a third one here. As you can see, each vertical line passes through only one point on the graph, which shows that every input has exactly one output. So what does this tell us? It tells us that this graph has passed the vertical line test, and yes, it is a function. Let's go ahead and look at functions versus |
| 00:01:20 | non-functions. Let's look at the left side of this slide first. We have a couple example graphs of functions. Let me go ahead and verify these examples that they truly are functions based on the vertical line test that we just talked about. Let me go ahead and draw in a vertical line here and another vertical line here. |
| 00:01:37 | As you can see, the first graph does pass the vertical line test because the line passes through exactly one point on the graph. Let's go ahead and look at the second graph. Let me draw in some vertical lines. I'm going to draw in one here. And I'm going to draw in one here. Even though it appears that the vertical line goes through |
| 00:01:58 | more than one point, it really does not. It just appears that it does. But it definitely does not, so it still is a function. Let's go ahead and look at the right side of the screen. If I drew in a vertical line here at x equals negative 2, yes, it does go through exactly one point. But let me go ahead and draw in another vertical line here and one more here. |
| 00:02:18 | So when I draw in some extra vertical lines, it does not pass the vertical line test. So that's why it's not a function, because the vertical lines go through more than one point. So sometimes you have to draw multiple vertical lines in the vertical line test. The last graph that we see here is a vertical line. So the input has infinitely many outputs, |
| 00:02:39 | which is not a function. So this is our look at functions versus non-functions. |

**Section 11**

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| 00:00:00 | TEACHER: You've been answering the lesson question, what is a |
| 00:00:03 | function, and how can I identify one? You just learned how to identify a function of a graph using the vertical line test. In this part of the lesson, you'll determine if a real world scenario, like the one you see here is a function. |

**Section 12**

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| 00:00:01 | TEACHER: Let's look at how to determine whether a real world |
| 00:00:03 | relationship is a function. We need to determine if the following scenario represents a function. Is the height of a football kicked across a field a function of the time? Well, a function is a relation in which one variable specifies a single value of another variable. For example, when you kick a ball, each second that passes |
| 00:00:24 | has one and only one corresponding height. Time only goes forward and never repeats itself. Let me sketch a graph of what this would look like. So, as the ball is kicked, it increases in height, reaches its maximum peak, and then comes back down just like this. Well, the height of the ball depends on how much time has passed since it left your foot. |
| 00:00:45 | This is a one way relationship. Although each moment of time is unique, it is possible for the ball to be at a particular height more than once as it goes up and then down. Knowing the time will tell you the height, but knowing the height won't give you an exact time. Yes, the height is a function of the time. Let's continue. |
| 00:01:06 | Here's an example of another scenario. A survey asked high school math students their ages and heights. The results are shown in the table. Is the height a function of the age? Well, let's determine if this is a function or not. Well, notice that there's a gap in the graph right down here. |
| 00:01:25 | Notice that the y-axis starts at 60 and the x-axis starts at 15. Well, in this scenario, as you can see from the table, people of the same age can be different heights. So we have two people at 16, and they have different heights. As you can see from the graph, the input of 16 years has two different outputs. |
| 00:01:51 | This scenario is not a function. So, this is our look at determining whether a real world relationship is a function. |