# Instructions for this Strategy

**Teacher Directions:**

Before addressing this standard, it's critical that students understand the associated vocabulary. Students won't be able to think of functions as a "vehicle for inputs and outputs" if they don't first understand what you mean by "inputs and outputs". Have them try to think of scenarios where you "input" one thing and an "output" is produced. Float over to the concept of cause and effect, how different causes, or inputs, will change the effect, or output. Once they have this understanding, move on to introducing that there are different ways to represent these "cause and effect" scenarios.

A great way to begin this introduction is through a discussion found at
http://www.shodor.org/interactivate/discussions/FunctionsAsProcesses/

Once they understand the idea behind the "Function Machine", have them either as a class, in groups, or in pairs create their own function machines, but now ask them to write down the input and output values. Explain that in the math world, we always write the input value first (or on the right side of a table), and the output value second (or on the left side of a table). This helps with continuity and understanding across the board, no matter who's looking at your table or coordinate pair.

Once each student has a few different working functions explained both through tables and English sentences, introduce the convention of algebraic representation using letters in place of the phrase "a number". One letter (not necessarily X) will represent the input, and one the output (not necessarily Y). If you'd like, have them use different letter for each function, so they get used to the idea that X and Y aren't the only variables we can use to represent inputs and outputs.

You might want to take the time to re-define some vocabulary in terms of what the students have just learned.

> The "inputs" and "outputs" students have been working with are both variables.
> The "inputs" are independent variables, because they stand alone-and are not affected by the function or the output.
> The "outputs" are dependent variables, because they are affected by the input and function.
> The "function machine" that students have been using is just another way of thinking of functions. Functions themselves are a process that takes input values and produces output values.

To help solidify these ideas for your students, have them pair up. Give them a list of different functions, some represented verbally (or written down in sentences), some represented as tables, and some as graphs.

Once students are fully able to identify different properties of functions algebraically, graphically, represented in tables, or verbally, start having them compare two different functions represented in

different ways. This might take a bit of practice, and you might need to take this time to identify any learning gaps students are having, and then reteach to fill in those gaps.

This lesson focuses on learning to think about functions through a new scope- and you can have a lot of fun with it! Interactivate by Shodor.org has many great games and other resources to help you when teaching this standard.

**Major Mistake Territory:**
An independent person is one that can live alone, and doesn't rely on other people, whereas a dependent person (think infant or small child) needs someone else to tell it what to do, where to do, how to act, etc. Using this terminology outside of the math classroom.

Students should have already been exposed to using graphs to represent functions, and it shouldn't be difficult for them to fit their new understanding about functions into graphical representations, but if you notice students having trouble carrying over some of these re-established ways of thinking, help point out how each individual piece is represented in a graph.

Some students might also have trouble translating these ideas into properties of quadratic functions, so it might be helpful to use examples of quadratic functions when making your "function machines", or when having them work in pairs.

Students will have learned how to look at two graphs of two different functions and know how to compare them for the same property, but they might struggle when comparing two different functions in two different formats such as a graph and an equation. If this happens, remind them to go back to the basic definitions they've learned, and how to identify each property. You might notice students finding it easier to represent functions in one specific format. If this happens, have them work on translating from whatever format the function is presented in to the format they prefer to work with. Doing this helps them be able to identify different properties in each format, but the actual comparison will be easier for them to see.