Math Institute Summer 2006

Monica Reece
Grenada Middle School, Grenada, MS
Grade: 6

# Function Machines

**Objectives**:
2a. The student will complete a function table.
2b. The student will determine the rule of a function table.
2c. The student will graph functions from function tables.

**Procedures**:

What is a function? One of the simplest ways to think about functions is as a machine: you put something into the machine, and it spits something back out. For example, a bubble gum machine. You put a quarter in, and seconds later you get a gumball. So, a function is a rule, often given as an equation, table, or graph that relates each member (usually a number) from one set of numbers to a specific member of another set. The equation y= 2x is a function that doubles each number x.

| | | | | | |
|---|---|---|---|---|---|
| X | 1 | 0.2 | 9 | 10 | 0 |
| Y | 2 | 0.4 | 18 | 20 | 0 |

(1x2=2) (0.2x2=0.4) (9x2=18) (10x2=20) (0x2=0)

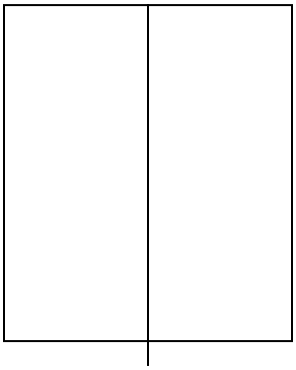
So, in general, a function is a set of rules for taking input and producing output. Most of the time in math the input and output are numbers. If I have a function called "Frances," and I input the number 5, Frances might output 10. If I input the number 3, Frances might output 6. So, it looks like Frances is the "take a number and double it" function. You could write this as F(x) = 2x,

which says that whatever the value of (x) is, the value of Frances (x) will be twice it.

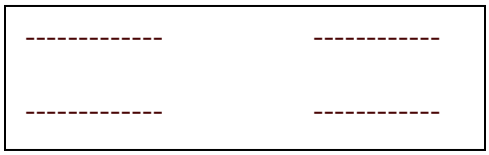
*The following activity for using function machines was adapted from the *Glencoe Mathematics* textbook (2001).

****Function Machines**: The student will use what they have learned about solving equations to help them work with function machines. A function machine takes a number called the *input*, performs one or more operations on it, and produces a result called the *output*. The students will work in small groups to complete the following activity. (Suggested group size is three):
Make a function machine for the rule **+5**.

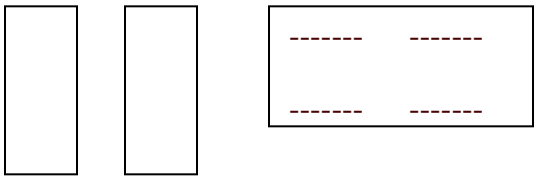
- Take a sheet of paper and cut it in half lengthwise.



- On one of the halves, cut four slits—two on each side of the paper. Make each slit at least two inches wide.



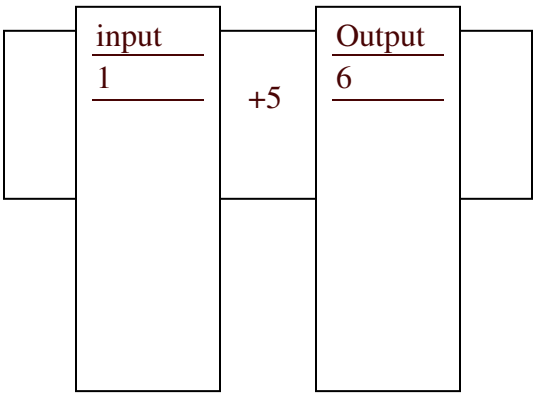
- From the other half of the paper, cut two narrow strips lengthwise. These strips should be able to pass through the slits you cut in the other half.




- On one of the narrow strips, write five consecutive numbers starting with 1. On the other narrow strip, write five consecutive numbers starting with 6. The numbers on both strips should align.

| | |
|---|---|
| 1 | 6 |
| 2 | 7 |
| 3 | 8 |
| 4 | 9 |
| 5 | 10 |

- Place the strips into the slits so that the numbers can be seen. Show 1 and 6. Once they appear, tape the ends of the strips together. When you pull the strips, they should move together. Mark the left strip *input*, and the right strip *output*. Write the function rule +5 between the input and output.




- Make a function table showing the input and output. Allow the student time to complete the table before discussing the output.

| Input | output |
|---|---|
| 1 | 6 |
| 2 | 7 |
| 3 | 8 |
| 4 | 9 |
| 5 | 10 |

Ask: What is the output when the input is 3? 5? Suppose you added more input numbers to the left strip. What would the output be if the input was 8? What is the output if the input is x?

****Completing a function table**:
To complete a function table the student should read the input data and interpret the rule. Then, write the output.
Example 1: (-1 + 3=2) (0 + 3=3) (3 + 3=6)

| Input | output(n+3) |
|---|---|
| -1<br>0<br>3 | ?<br>?<br>? |

Example 2: When working with the examples, the output numbers are not there. The teacher will guide the students as they complete the table.

(1/4 x 4= 1) (1/4 x 8= 2) (1/4 x 12= 3)

| Input | Output (1/4n) |
|---|---|
| 4<br>8<br>12 | 1<br>2<br>3 |

The students will draw and complete function tables using the following information:

1) Input (-3, 0, 3) and the rule is (n + 4)
2) Input (0, 3, 4) and the rule is (3n)
3) Input (5, 6, 7) and the rule is (5 – n)

****To find the rule for a function table**:
To find the rule of a function table, the student will read and interpret the input and output. Then write a rule. Remember, the rule determines the output. Find the rule for each function table:
Example 1. Allow the students time to interpret the rule before discussing it. Output is (4n): (1 x 4=4) (2 x4=8) (3 x4= 12)

| Input | output |
|---|---|
| 1 | 4 |
| 2 | 8 |
| 3 | 12 |

| Input | Output |
|---|---|
| 0 | 0 |
| 2 | 1 |
| 4 | 2 |

Example 2: The output is (n÷2): (0 ÷ 2= 0) (2 ÷ 2 =1) (4 ÷ 2= 2)
The students will copy each function table and determine a rule for each function table. Remember, the rule determines the output.
1) Input(n)= 0, 3, 6 2) Input= -2, 1, 3 3) Input= 5, -5, 0, -1
Output= -3, 0, 3 Output= 4, 2, -6 Output= 25, 25, 0, 1

Allow the students time to respond before discussing the results.

****Graphing Functions**:
Introduction: Getting an allowance of $2 a week is an example of a function. The equation y= 2x, where y is the amount received and x is the number of weeks, will give you the total allowance received after the number of weeks you choose. In the equation, y= 2x, x is the input, and y is the output. The function rule is 2x.

We can use the coordinate grid system to graph an equation or function. To graph a function follow these steps:
1) Record the input and output in a function table. We chose 0, 2, 4, and 6 for the input. List the input and output as ordered pairs (x,y).
2) Graph the ordered pairs from the table in step 1 on the coordinate plane. The x-coordinates represent the number or weeks in our introductory problem. The y-coordinates represent the total allowance received after x weeks.
3) The points appear to lie on a line. Draw the line that contains theses points. The line is the graph of y= 2x.

- Use transparencies to show how to graph the ordered pairs. Explain that the x-coordinate should be graphed first and the y-coordinate graphed second. The x and y represent the axis on the coordinate plane. Always start at the origin (0, 0) when graphing. Once you find the location on the grid, identify it with a point.

**Assessment**:
1. The students will complete performance tasks as they work in groups. ( attachment 1)
2. The students will complete activity sheets on completing function tables and writing a rule for a given function as a grade. (attachment 2)

**Materials**:
1. Function Machines: each group needs paper, scissors, tape, and a pencil or marker
2. Activity sheets ( attachments 1 and 2)
3. Transparency sheets (completing and graphing functions)

**References:**
Glencoe Mathematics ( 2001) McGraw-Hill Publishing.
WWW.mathforum/.org

Attachment 1

# Function Machines

Use your function machine to answer the following questions.

1. The output is _____when the input is 3.

2. The output is _____when the input is 5.

3. The output is _____when the input is 8.

4. The output is _____when the input is x.

5. a. The output is _____when the input is 4.

   b. The output is _____when the input is 6.

   c. The output is _____when the input is 7.

   d. The input is _____when the output is 33.

6.

| Input | Output |
| --- | --- |
| | |

Temperature is usually measured in Celsius (˚C) or Fahrenheit (˚F). The formula for changing from Celsius to Fahrenheit is $F= \frac{9}{5} x\ C + 32$. This formula is like a function. The input is the Celsius temperature, and the output is the Fahrenheit temperature. Find the output of each input.

7. a. 60 degrees = _____

   b. 15 degrees = _____

   c. 0 degrees = _____

   d. -10 degrees = _____

8. Use the function rule to find the set of outputs that correspond to the set of inputs 1, 3, 5, and 7. Rule: 3x – 2

Output values _____.