WAMC Lab Template

Math Concept(s): Introduction to Functions
Source / Text: Matt's Brain
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Attach the following documents:

- Lab Instructions

I will assign the following roles to nine students:
1 – Vending Machine – This student will be given sheets of paper that relate the inputs and the foods. One sheet (A) will be a good function where each input correlates to a unique piece of food. One sheet (B) will be a good function where two inputs map to the same food. One sheet (C) will be a good function where the inputs all map to the same piece of food. One sheet (D) will be a bad function where one of the inputs will connect to two different pieces of food.
4 – Input Values – Four students will each be given a sheet of paper with one of the numbers from 1 to 4.
4 – Food – Four students will each be given a sticky note with one of the following words: Chocolate, Taffy, Cookie, Broccoli

Food people will stand at the front of the room. The Vending Machine will be handed functionality sheet A. It is the person's job to match input values to food. That person will ask each input person to stand next to the food and point at it. This is an example of one-to-one functionality. The same goes for B (another example of a good function), C (constant function), and D (not an explicit function).

After the vending machine student is finished assigning the inputs, explain what each function is, why it's considered a good or bad function, and how this is useful in industry. This simple lab is an example of the UPC (Universal Product Code) system. Each numerical input is assigned to a product. The scanner scans the barcode, reading the input UPC. The computer then registers which item it is based on a function (programmed by humans).

This type of functionality must be manually entered. That is, each discrete input has a unique output, and each must be programmed accordingly. In mathematics, functions can be generalized for any input (variables). These are powerful functions that work when called upon.

The sheets will have the following information:

A

1→Chocolate
2→Taffy
3→Cookie
4→Broccoli

B

1→Cookie
2→Cookie
3→Chocolate
4→Taffy

C

1→Taffy
2→Taffy
3→Taffy
4→Taffy

D

1→Chocolate and Taffy
2→Broccoli
3→Taffy
4→Cookie

- Student Handout(s)

Functions

What is a mathematical function. You saw in today's lab that functions map inputs to outputs. For example, each number corresponded to a specific food. But mathematical functions utilize mathematical things (no food, unfortunately). What we need is a way to make functions easy to understand by using some sort of shorthand. That's what we are learning today: we are making functions. We are not solving anything! We are learning about function notation and how to evaluate functions. Let's take a look at an example from today's lab.

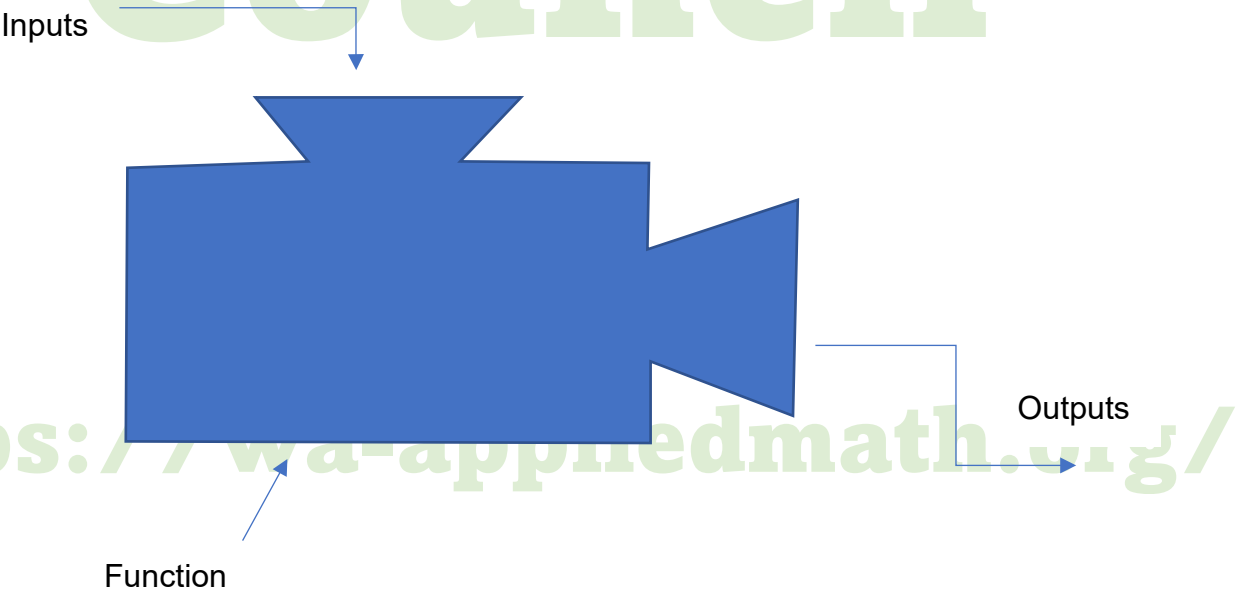
Vending Machine(1) → Chocolate

Name of the function Input Value Output Value

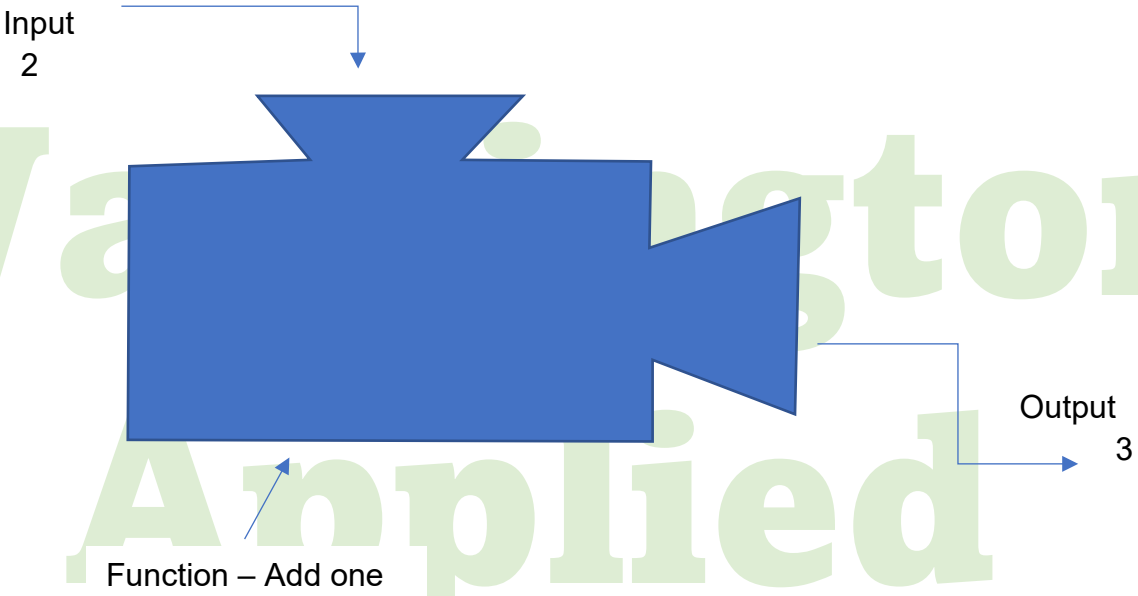
To shorten this, we could use the following:

VM(1) = Chocolate

A function is just a machine that links inputs and outputs!



Let's have our machine do something simple… like add 1 to the input…



We could also write it as this

$$f(2) = 3$$

Notice that we are calling our machine "f" (for function). We can call it whatever we want, but functions are given the name "f" as a default. In other words, you are going to see many functions that are named "f", but they're not all the same function.

What if we put in other values, like 10, -5.3 or 100π?

$$f(10) = 11$$
$$f(-5.3) = -4.3$$
$$f(100\pi) = 100\pi+1$$

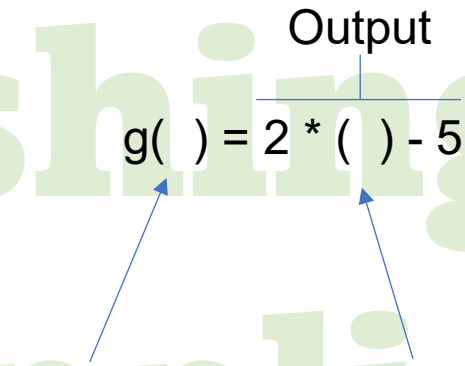
Could we put in something weird? Sure….

$$f(\text{elephant}) = \text{elephant} + 1$$
$$f(\Omega) = \Omega + 1$$
$$f(\ \ ) = (\ \ ) + 1$$

In the last example, we see that the set of parentheses is a placeholder for any value that we want to choose. That's why people usually put an x instead…

$$f(x) = x + 1 \text{ or}$$
$$f(x) = (x) + 1$$

Let's make a more complex function. What we're going to do is make a function that takes the input, multiplies it by 2, then subtracts 5 from the product. Let's call that function "g". How are we going to write out the function and its definition? Hint: When in doubt, just start with parentheses on the right, then replace all of the parentheses on the right with x's.



$$g(x) = 2x - 5$$

With g defined above, we notice that g(7) = 9, g(-3) = -11, etc.
Can we create a function that squares the input? Sure!

$$f(x) = x^2$$

Notice that this function is called "f" as well. If $f(x) = x^2$, then f(4)=16, f(10)=100, etc. This function is different than the one above, so function names *depend on the context*. In the future, each math problem that you see is *independent* from any other math problem, so you will see many functions named "f".

Below, I would like you to make your own functions! Give the definition of the function, its shorthand [or mathematical notation, like f(x) = whatever you choose], and two examples of numerical inputs and outputs for each function.

- Rubric and/or Assessment Tool

Exit Ticket Problems

1. What is the explicit form of a function that adds 5 to the input and outputs the result? As an example, f(x) = 3x is a function that multiplies the input by 3 and outputs the result.

2. What is the explicit form of a function that multiplies the input by 10 and adds 8 to the product to form the final product?

3. If $g(x)=x^2+4$, what is g(3)?

Example Quiz Problems

1. If f(3) = 5, what is the..
    a. Function's Name?
    b. The Input?
    c. The Output?
2. If f(x) = 3x-5, what is f(10) equal to?
3. How can we express a function that takes an input, multiplies it by 1/2 , then subtracts 5 from the result? (in case you didn't know, subtracting x from y can be written as y – x)

Short Description (Be sure to include where in your instruction this lab takes place):

Lab Plan

Lab Title: Human Vending Machine

Prerequisite skills: Numeracy, Problem Solving

Lab objective: Students will learn function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Short Description (Be sure to include where in your instruction this lab takes place):

Lab Plan

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Prerequisite skills: Numeracy, Problem Solving,

Lab objective:

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*
Mathematics K–12 Learning Standards: F-IF.1 Understand the concept of a function and use function notation

Standards for Mathematical Practice:

- Standard Number 2 for High School: High school students seek to make sense of quantities and their relationships in problem situations. They abstract a given situation and represent it symbolically, manipulate the representing symbols, and pause as needed during the manipulation process to probe into the referents for the symbols involved. Students use quantitative reasoning to create coherent representations of the problem at hand; consider the units involved; attend to the meaning of quantities, not just how to compute them; and know and flexibly use different properties of operations and objects.

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations
Critical Thinking and Problem Solving
☐ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
☐ Solve Problems
Communication and Collaboration
☐ Communicate Clearly
☐ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐ Access and Evaluate Information
☐ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☐ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☐ Manage Goals and Time
☐ Work Independently
☐ Be Self-Directed Learners
Social and Cross-Cultural
☐ Interact Effectively with Others
☐ Work Effectively in Diverse Teams

Productivity and Accountability
☐ Manage Projects
☐ Produce Results
Leadership and Responsibility
☐ Guide and Lead Others
☐ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- 12 Sheets of Paper – Four with Food, four with numbers, four with functions

Set-Up Required:

- Make the sheets of paper
- Print the worksheets

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Student Leader will have the task of arranging the students in proper order.
- Notetakers will write additional notes for classmates and absent students

Cooperative Learning:

- Students will be interacting with each other when evaluating others' functions.

Expectations:

- Students will have a baseline understanding of function notation and how to evaluate a function.

Timeline:

- The entire lesson, including lab and assignment, should take an entire block period of 120 minutes. This is the first lesson in the unit (2 weeks, approximately).

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- UPC
- Computer Applications
- Search Engines
- Data Queries

Career Applications

- Computer Applications
- Engineering
- Science