emcsquared: How b Depends on a

Title:	**Grade:** 7 and 8	**BIG Idea:**
How ***b*** Depends on ***a*:** One-step function rules	**Author**:Hope Phillips	Algebraic Expressions & Functions

Prior Knowledge Needed:

- Understand operations with integers
- Absolute value - M7N1a: find the absolute value of a number and understand it as the distance from zero on a number line; (mastery of objective not necessary to use applet but increases the number of available applet problems)
- Exponents - recognize that an exponent is used to represent repeated multiplication of a factor; (mastery not necessary to use the applet but increases the number of available applet problems)

GPS Standards:

M7A1. Students will represent and evaluate quantities using algebraic expressions.

M8A3. Students will understand relations and linear functions.
a. Recognize a relation as a correspondence between varying quantities.
b. Recognize a function as a correspondence between inputs and outputs where the output for each input must be unique.
d. Recognize functions in a variety of representations and a variety of contexts.

M7P1/M8P1. Students will solve problems (using appropriate technology).

M7P3/M8P3. Students will communicate mathematically.

Objectives:

1. Students will write algebraic expressions in terms of ***a*** for ***b***.

2. Students will understand the relationship between ***a*** and ***b*** as a function.

Materials:

Computer lab or laptops
Digital projector
Computer
Applets (see *Resources* section below)

Task:

Using the applet, try to figure out how the number b depends on the number a. To do this, move the

point a over the number line (click and drag the small blue ball) and try to identify what happens with the point b. To check your answer, write in the text field below an algebraic expression in terms of a and, then, click on the button, “Am I right?” **It is important that your answer matches with point b for all positions of point a!** At the end of the applet page, you will find a list of function commands.

Description and Teacher Directions:

After completing this applet, students should understand the concept of a function in the form of an algebraic equation. It is not necessary to introduce students to *function notation* in order for them to understand the concept of a function. However, *function notation* reinforces the idea that one variable does, indeed, depend on the other for its value.

If students have difficulty with the abstract nature of this applet, introduce them first to the *National Library of Virtual Manipulatives Function Machine (*link below*)*.

http://nlvm.usu.edu/en/nav/frames_asid_191_g_3_t_2.html?from=category_g_3_t_2.html

A simple applet, students are only asked to look for number patterns in an input-output table. However, this applet provides practice with the concept of a function -- that there is one unique output for every input. Students must recognize the pattern and use a recursive rule to express it. Recursive rules explain how a pattern changes from any given step to the next step. For example, given the input-output table below,

1	2
2	4
3	8
4	16

the recursive rule is "double the previous output value" or "multiply by two the previous output value".

The *Number Cruncher applet* (see link)http://www.shodor.org/interactivate/activities/NumberCruncher/ builds on the *Function Machine* applet by asking students to supply a rule for the function. The rule is not written using *function notation* but, instead, is a simplified format for expressing the rule observed in the input-output table. The rule is expressed as follows:

Output = Input (+, -,*) _____

which can be explained as "the output value is equal to the input value plus, minus, or multiplied by some number". This type of rule is *explicit*. Explicit rules determine the number of elements (i.e. *output*) in a step from the step number (i.e. *input*).

Stating an explicit rule helps students get ready to use *function notation*. Focus instruction on two key concepts:

Teacher Commentary:

1. The value of the output *depends* on the value of the input.
2. For each input value there is exactly one (i.e. unique) value for the output.

The applet *How **b** Depends on **a*** requires students to transfer from more concrete representations of functions (previous two applets) to a more abstract one. Students try to determine how the value of variable **b** depends on variable **a.** As students slide point **a** up and down the number line, they should notice what is happening to the position (value) of point **b.**

An important point to mention is that only point **a** may be manipulated. The moving of point **a** reinforces the meaning of a function -- that the value of **b** *depends* on the value of **a**.

Encourage students to move point **a** to numerous places on the number line before developing an explicit rule representing how points ***a*** and ***b*** are related.

Students should understand the following about *function notation:*

1. The notation on the worksheet is read, "**b** is a function of **a**". Normally, this is written as f(a) = b. However, in this case, it is helpful for students to understand that ***b*** is equal to ***f* of *a*** [how the notation *f(a)* is said aloud] when the algebraic expression on the right-hand side of the equation is evaluated **for *a***.

2. The variable ***b*** can be replaced with an algebraic expression. This algebraic expression forms an explicit rule that will be true for the value of ***b*** given any ***a***. This rule will be written in *function notation* but relates to the more simplified rule from the *Number Cruncher* applet. Recall the *Number Cruncher* rule format --

Output = Input (+, -,*) _____

b = f(a)

Enter the algebraic expression representing the relationship between ***a*** and ***b*** in the space provided on the applet. The expression will always be written in terms of ***a*** because we are trying to find the value of ***b***, which is dependent on the value of ***a***.

By emphasizing this *dependent* relationship between ***a*** and ***b*,** students will better understand the concepts of independent and dependent variables when they begin graphing linear functions.

All of the mathematical notations necessary for completing this activity are shown at the bottom of the applet. If there are relationships between the variables that students have not yet learned (i.e. absolute value or exponents), simply select the link that says, "Click here to try a new challenge" to change to a new problem situation.

Resources:

How ***b*** Depends on ***a*** Applet

http://www.uff.br/cdme/c1d/c1d-html/c1d-en.html

(Basic) Function Machine

http://nlvm.usu.edu/en/nav/frames_asid_191_g_3_t_2.html?from=category_g_3_t_2.html

(Advanced) Function Machine Applet

http://www.shodor.org/interactivate/activities/NumberCruncher/