

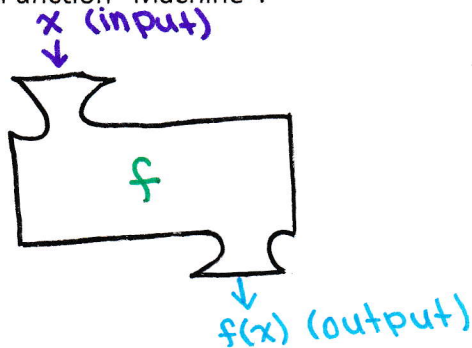
## Lesson 2.1 & 2.2: What is a Function? & Graphs of Functions

### What is a Function?

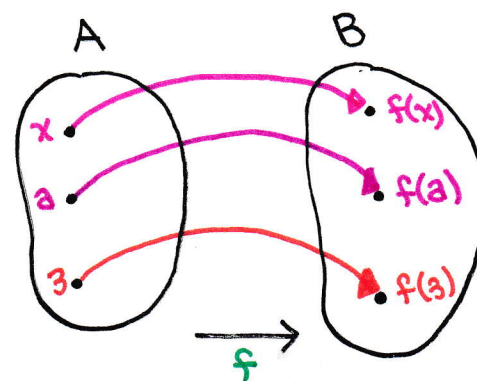
A function  $f$  is a rule that assigns each element  $x$  in a set A exactly one element, called  $f(x)$ , in a set B.

In other words each **input** of a function has exactly one unique output.

The Function "Machine":



Arrow Diagrams:



### Evaluating a Function

In functions the independent variable  $x$  acts like a placeholder.

Examples: Evaluate the following function for the given inputs.

$$f(x) = 2x^2 + 3x - 1$$

$$\begin{aligned} 1. f(2) &= 2(2)^2 + 3(2) - 1 \\ &= 2(4) + 6 - 1 \\ &= 8 + 5 \\ &= 13 \end{aligned}$$

$$\begin{aligned} 2. f(h) &= 2(h)^2 + 3h - 1 \\ &= 2h^2 + 3h - 1 \end{aligned}$$

$$\begin{aligned} 3. f(x^2) &= 2(x^2)^2 + 3(x^2) - 1 \\ &= 2x^4 + 3x^2 - 1 \end{aligned}$$

$$\begin{aligned} 4. \frac{f(a+h) - f(a)}{h} &= \frac{2(a+h)^2 + 3(a+h) - 1 - [2(a)^2 + 3a - 1]}{h} \\ &= \frac{2a^2 + 4ah + 2h^2 + 3a + 3h - 1 - [2a^2 + 3a - 1]}{h} \\ &= \frac{4ah + 2h^2 + 3h}{h} \\ &= 4a + 2h + 3 \end{aligned}$$

Four Ways to Represent a Function

1. Verbal
2. Visual (Graph)
3. Algebraic
4. Numerical (Table of Values)

Example:

Let  $F(c)$  be the Fahrenheit temperature corresponding to the Celsius temperature  $C$ .

The verbal description is given below, find the algebraic, visual, and numerical descriptions.

<p><u>Verbal:</u></p> <p>"To convert Celsius to Fahrenheit, multiply the Celsius temperature by <math>\frac{9}{5}</math> and then add 32."</p>	<p><u>Algebraic:</u> (equation)</p> $F = \frac{9}{5}C + 32$										
<p><u>Visual:</u> (graph)</p>	<p><u>Numerical:</u> (table)</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 5px;"><math>C</math> (Celsius)</td> <td style="padding: 5px;">-10</td> <td style="padding: 5px;">0</td> <td style="padding: 5px;">10</td> <td style="padding: 5px;">20</td> </tr> <tr> <td style="padding: 5px;"><math>F</math> (Fahrenheit)</td> <td style="padding: 5px;">14</td> <td style="padding: 5px;">32</td> <td style="padding: 5px;">50</td> <td style="padding: 5px;">68</td> </tr> </table>	$C$ (Celsius)	-10	0	10	20	$F$ (Fahrenheit)	14	32	50	68
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The Vertical Line Test

To test if whether or not curves of graphs are functions, you can use the vertical line test.

A curve in the coordinate plane is the graph of a function if and only if no vertical line intersects the curve more than once.

Examples:

