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LEARNING OBJECTIVE: We will formally define a function and see that some functions can be expressed by a rule or formula. (G8M5L2)

CONCEPT DEVELOPMENT:

A <u>function</u> is a rule or formula that assigns to each input exactly one output.

Functions are used to describe **PREDICTIVE** relationships.

ASSIGNS MORE THAN 1 OUTPUT FOR SPECIFIC INPUTS

Remember the previous example about the stone falling...
Here are two tables of values:

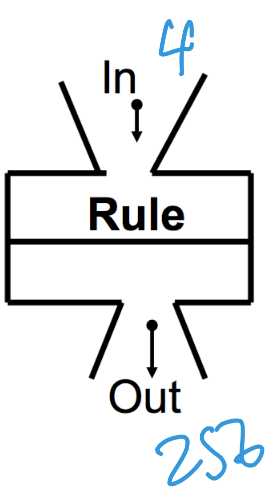
Number of seconds (x)	Distance traveled in feet (y)
0.5	4
1	16
1.5	36
2	64
2.5	100
3	144
3.5	196
4	256
x	$16x^2$

Number of seconds (x)	Distance traveled in feet (y)
0.5	4
1	4
1	36
2	64
2.5	80
3	99
3	196
4	256

IMPOSSIBLE!!

IMPOSSIBLE!!

Which table above allows us to make better predictions about the distance the stone travels? Why?



<u>Input-Output machine</u>: You can think of functions as input/output machines. If you feed an input into the machine and apply a rule, you will get an output.
<u>Example</u>: Input (x-value) a 3, and output (y-value) a 5. Input 7 and output 9. Input 12 and output 14. What's the rule being applied?

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Is it linear?

Functions can be represented 4 different ways:

Verbal Description

A stone falls from a height of 256 feet in exactly 4 seconds.

Need more info to determine linearity

Formula:

$y = 16t^2$

not linear because t^2

Does the formula work for the values in the table?? YES.

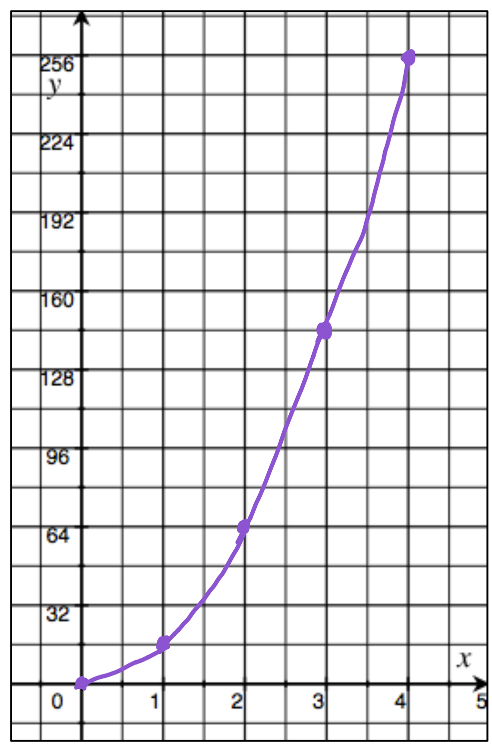
Tables

Time in seconds (t)	Distance traveled in feet (y)
0.5	4
1	16
1.5	36
2	64
2.5	100
3	144
3.5	196
4	256

Not linear (i.e. slope is changing)

$\frac{16-4}{1-.5} \neq \frac{36-16}{1.5-1}$

Graphs



Not linear - line is CURVED!!

What does it mean to assign each input **EXACTLY ONE OUTPUT** in the context of the stone falling?? At any given point in time, we should be able to identify how far the stone travels

Why is context important when considering functions? What if $t = -2$?

we don't have negative time

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Guided Practice:

Steps for Defining Functions

1. Consider the input and output values.

a. If one input value has MORE THAN ONE OUTPUT value, your relationship is NOT a function.

b. If each input value has only one output value, then your relationship is a function.

2. Look at the relationships between the input and output values to see if there is a rule you can create to predict other values of the function.

Input (x)	Output (y)
1	7
3	16
5	19
5	20
9	28

Is this a function? Why/why not?

Not a function

$5 \to 19$, $\to 20$

Is there a rule you can build?

No.

Input (x)	Output (y)
0.5	1
7	15
7	10
12	23
15	30

Is this a function? Why/why not?

Not a function.

$7 \to 15$, $\to 10$

Is there a rule you can build?

Input (x)	Output (y)
10 ×3.2	32
20 ×1.6	32
50	156
75	240
90 ×3.2	288

Is this a function? Why/why not?

Yes. There are no repeating inputs.

Is there a rule you can build?

No!

Input (x)	Output (y)
34	10
51	15
68	20
340	100
85	25

Is this a function? Why/why not?

Yes. Each input is assigned to 1 output

Is there a rule you can build?

Yes! $y = \frac{x}{3.4}$

What will y be when $x = 17$?

$\boxed{y=5}$

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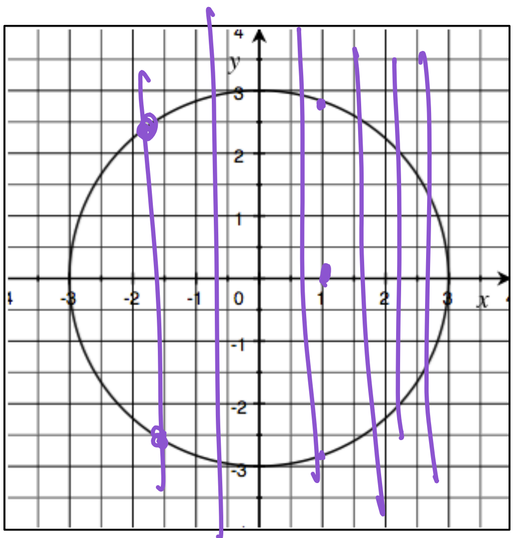
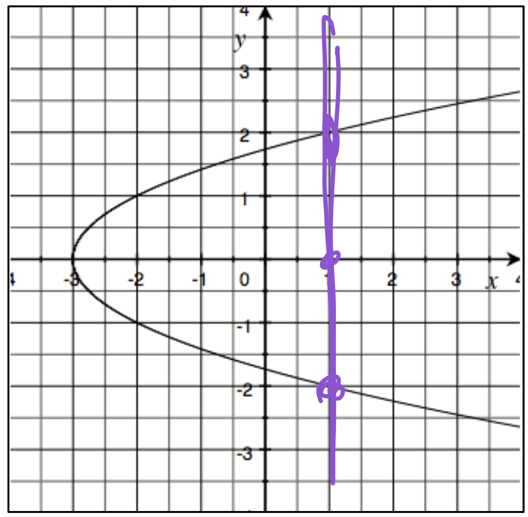
Look at each of the graphs below. Do these graphs represent functions? Is each input (x) assigned to only one output (y)? How do we visually know when a graph is a function?

VERTICAL LINE TEST

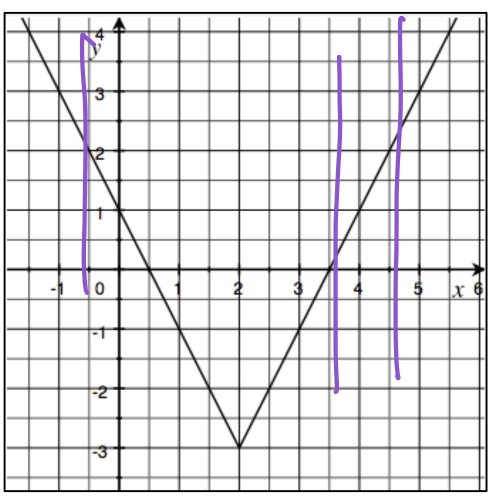


No function

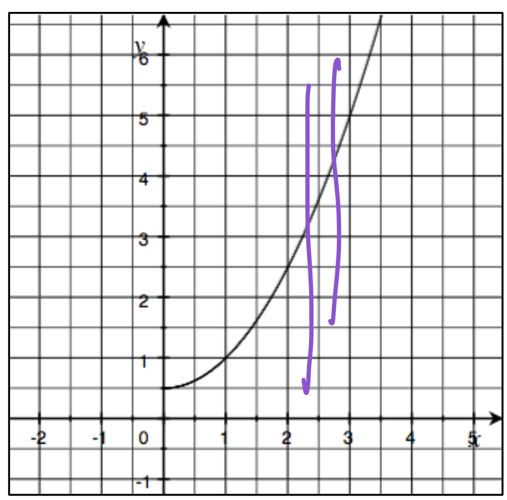
$x^2+y^2=9$



No functions



Absolute value function yes!



Yes. Passes vertical line test.

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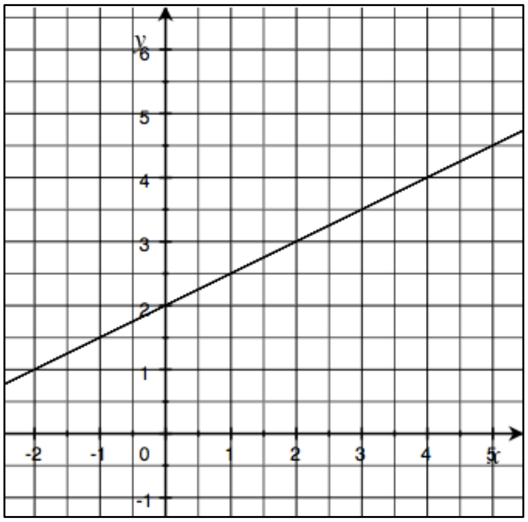
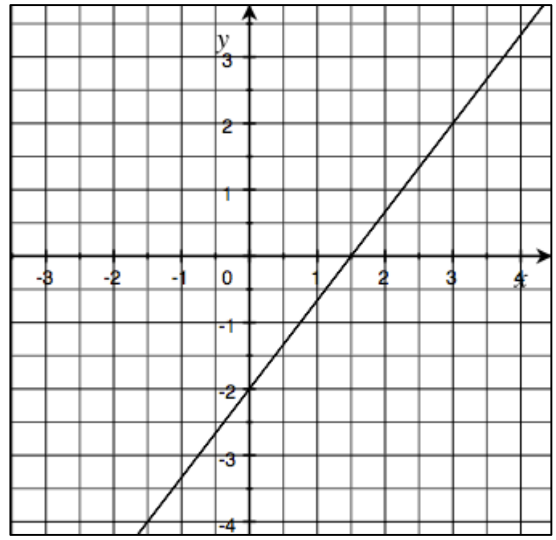
Activating Prior Knowledge:

We can write linear equations from graphs





Closure:

Consider the 2 tables below. How would you explain to someone who was absent today that table in part a is a function and the table in part b is not a function.

a.

Input *(x)*	-1	-2	-3	-4	4	3	2	1
Output *(y)*	81	100	320	400	400	320	100	81

b.

Input *(x)*	1	6	-9	-2	1	-10	8	14
Output *(y)*	2	6	-47	-8	19	-2	15	31