Mathematical Functions – Why Do I Need to Know About Them?

- The webinar will start at 3:30 pm EDT/ 2:30 pm CDT.
- If you have a technical question before the webinar, please type it into the question panel. We will do our best to answer your question.
- When you log on, check your audio to make sure your headphones are working properly.
- If you use your phone to call in, be sure to enter the appropriate codes.
- As you enter the webinar, your audio will be muted to avoid a lot of background noise.
- You will not hear anything until 3:30 p.m. when the webinar goes live, so please don't think that anything is wrong.
- If you haven't downloaded the PowerPoint handout and guide, please feel free to do so from the handout panel.

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Mathematical Functions – Why Do I Need to Know About Them?

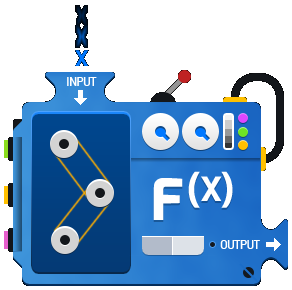
Tuesdays for Teachers

February 28, 2017

Welcome!

- Daphne Atkinson, GED Testing Service
- Debi Faucette, GED Testing Service
- Bonnie Goonen, Consultant to GEDTS
- Susan Pittman, Consultant to GEDTS

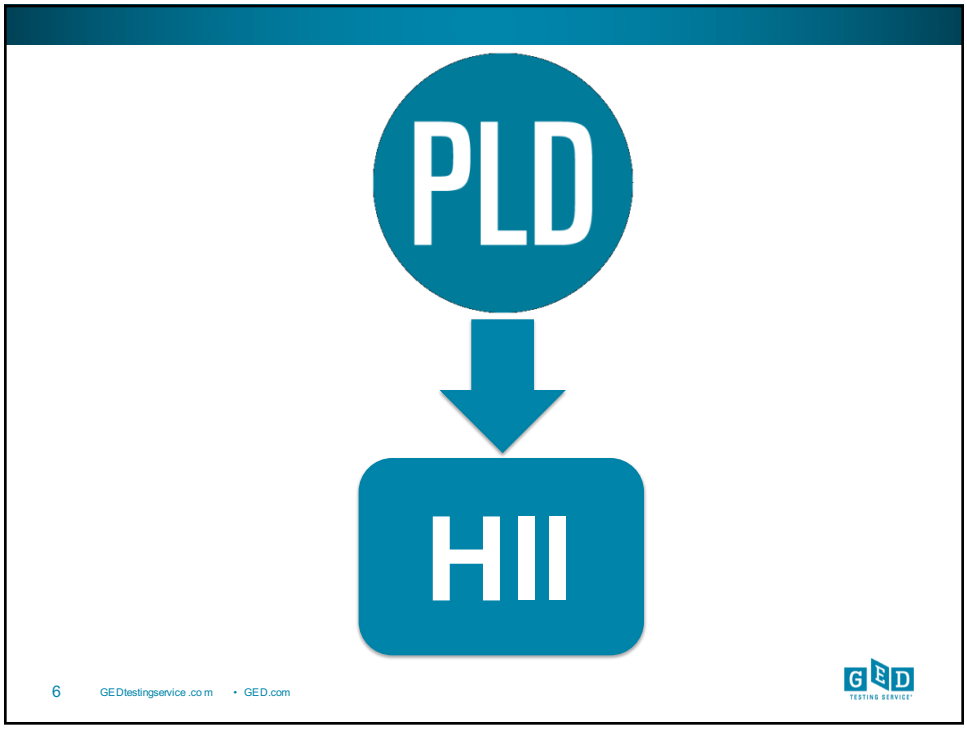
Objectives



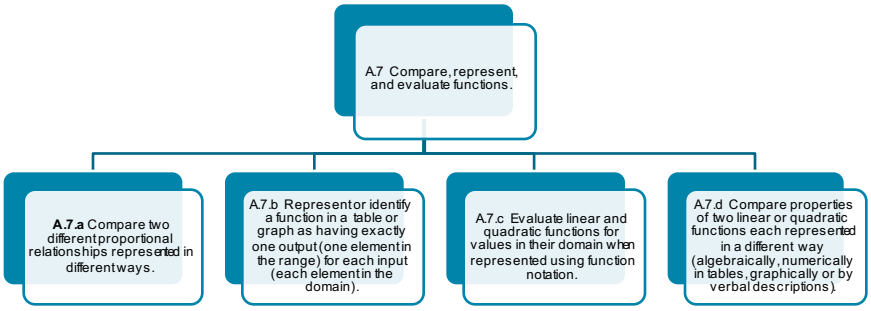
- Discuss using High Impact Indicators to drive instruction
- Review the basics of mathematical functions
- Investigate importance of students' understanding of functions
- Share resources and ideas

Skill Sets for High Impact Indicators in Mathematical Reasoning

Focusing Instruction



Descriptors for Functions



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Can your students . . .

Identify functions and non-functions displayed in graphs and tables, and create functions (graphs/tables)?

Substitute values for variables in functions and evaluate the resulting numerical expressions?

Convert functional representations from one from to another, and compare properties of the functions?

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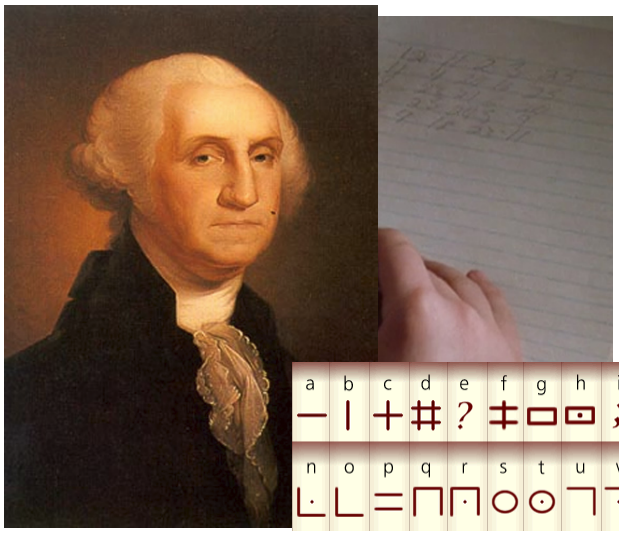
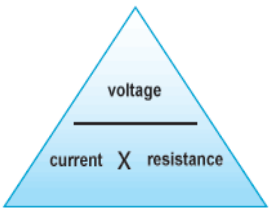
What is a function?

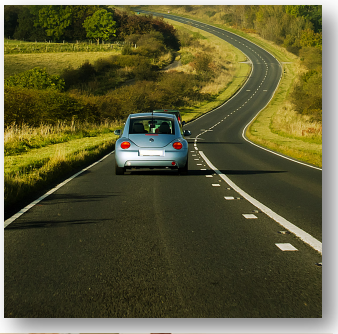
A **function** is a special relationship between a set of inputs and a set of permissible outputs. It is a useful mathematical tool.

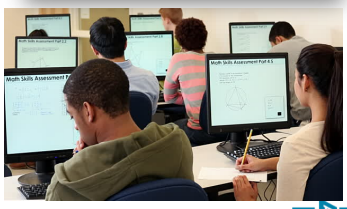
A Secret Code



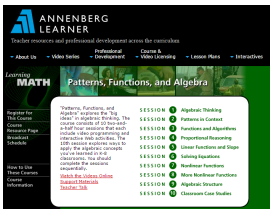
Functions in Daily Life







Resources



- Patterns, Functions, and Algebra – Annenberg Learner https://www.learner.org/courses/learningmath/algebra/
- Math in Practice Series from NCTM: *Putting Essential Understanding of Functions into Practice* - Robert Ronau, Dan Meyer, Terry Crites

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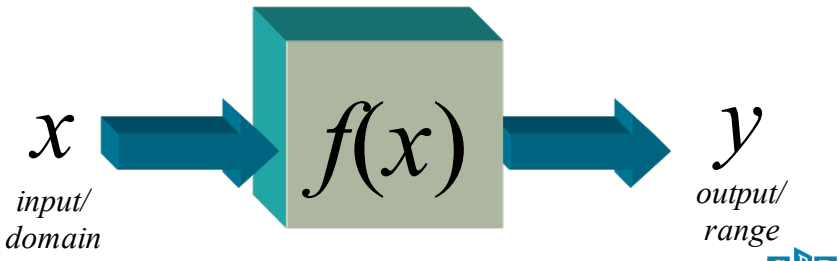
What is a function? Looking Closer

A **function** is a relation in which each element of the domain is paired with *exactly one* element of the range. Another way of saying it is that there is one and only one output (y) with each input (x).



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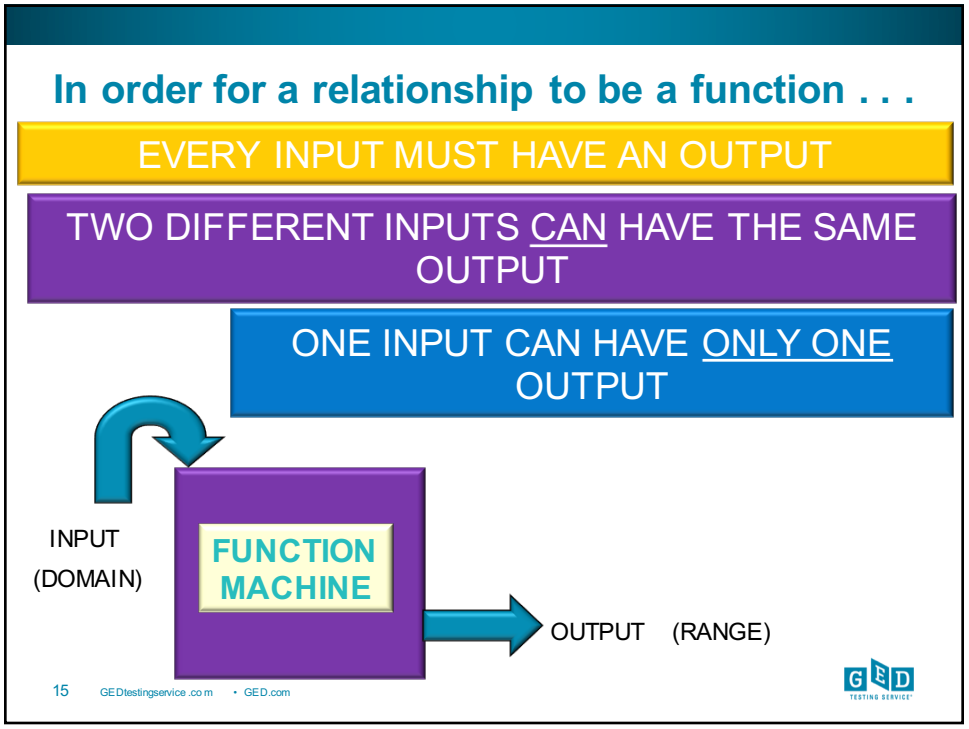
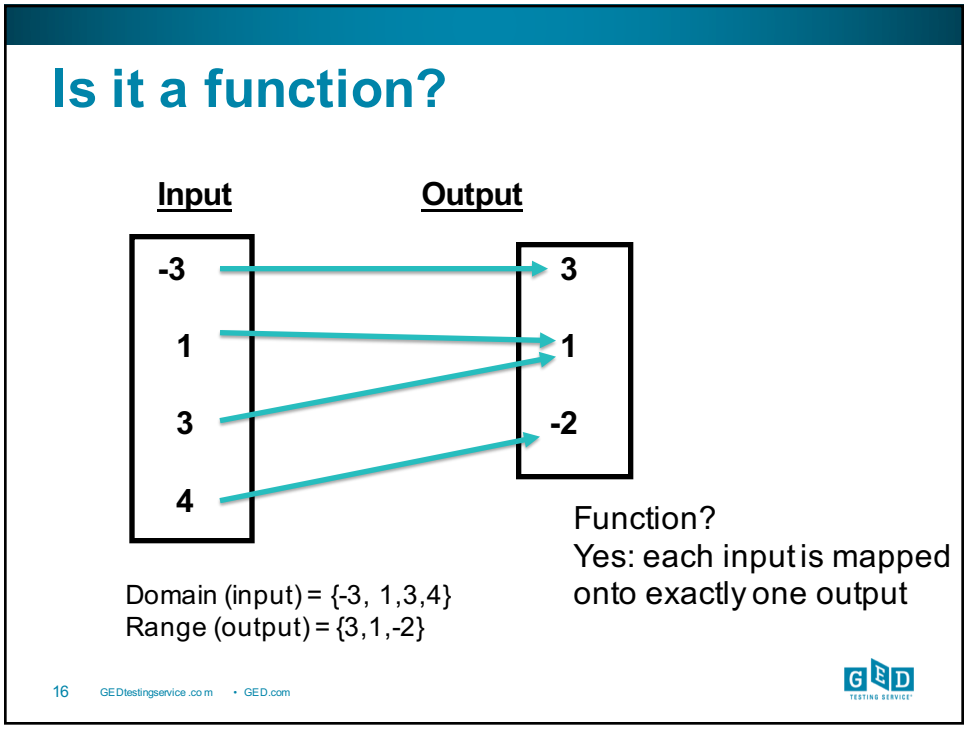




Real World – Is It a Function?

People and Social Security Numbers

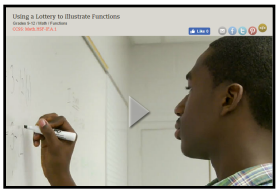
Domain	All people with a valid social security number
Range	All valid social security numbers
Is it a function?	Yes

Real World – Is It a Function?

People and Phone Numbers

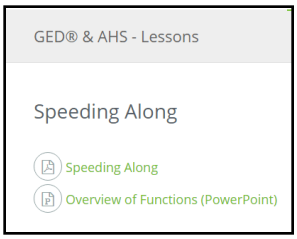
Domain	All people who have a phone
Range	Phone numbers of all people who have a phone
Is it a function?	No

Resources – Beginning Looks



- Using a Lottery to Illustrate Functions - The Teaching Channel

  https://www.teachingchannel.org/videos/teaching-functions?utm_source=Alpha+List&utm_campaign=17fa2b7690-



- Speeding Along

  http://www.floridaipdae.org/index.cfm?fuseaction=resources.GEDAHS&cagiid=A37BC967EEFD18737E7AC2AF2D8421DD4A11C694934330A61EB65F4EB10E766B

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Show Functions Four Ways

x	y
-4	-11
-2	-7
0	-3
2	1
4	5

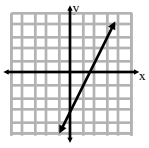
Table

$y = 2x - 3$

Equation

y is 3 less than twice a number x

Written Description



Graph

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Vocabulary

x	*y*
Input	0utput
Domain	Range
Independent Variable	Dependent Variable
x	f(*x*)

Is it a function? Creating Input/Output Tables

{(-5,3), (6,5), (3,2), (1, -3)}

There is only one output for each input. A relationship does exist, so yes, it is a function.

Input x	*Output y*
-5	3
6	5
3	2
1	-3

Is it a function? Creating Input/Output Tables

{(4,3), (-2, 10), (4, -6), (10,7)}

There are two inputs that are the same number, but each has a different output. A relationship does not exist, so no, it is not a function.

Input x	*Output y*
4	3
-2	10
4	-6
10	7

Is it a function?

x	*y*
-10	43
-15	2.5
52	3
33	6
-10	5.5
0	4
53	5

True or False?
Why?

Is it a function?

True or False?
Why?

x	0	-1	-2	4	0	2	1
y	-1	-2	-3	-4	-1	-5	-6

Is it a function?

Which of the following relations are functions?

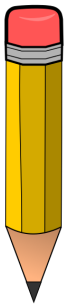
R= {(9,10), (-5, -2), (2, -1), (3, -9)}

S= {(6, a), (8, f), (6, b), (-2, p)}

T= {(z, 7), (y, -5), (r, 7) (z, 0), (k, 0)}

Is it a function?

Vertical Line Test: *a relation is a function if a vertical line drawn through its graph, passes through only one point.*



AKA: ***"The Pencil Test"***

Take a pencil and move it from ***left to right (–x to x)****; if it crosses more than one point, it is not a function.*

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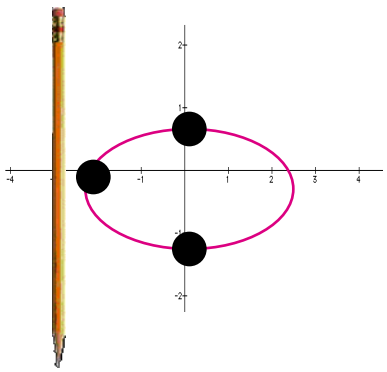
Vertical Line Test



Would this graph be a function?

NO

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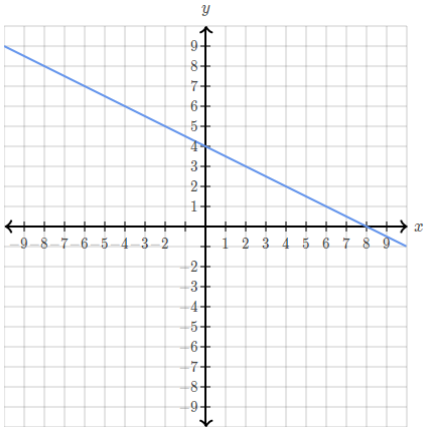
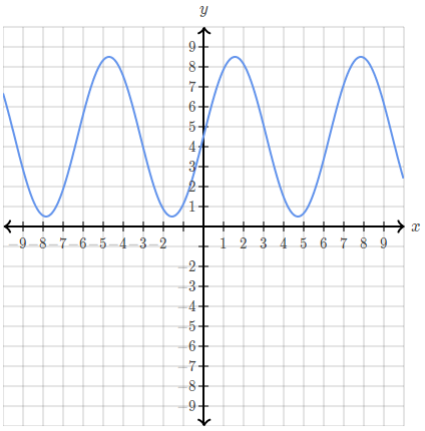
Is it a function?

Yes

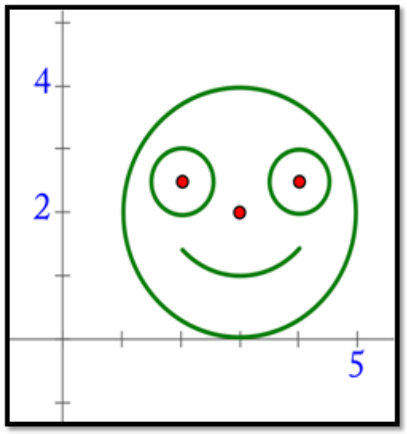


Is it a function?

Yes

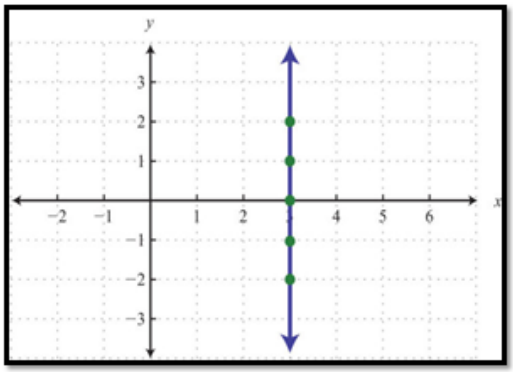


Is it a function?



No

Is it a function?



No

Back to Real-World Situations

Is it a function?

- The relation of distance and time during a trip.
- The relation of a month to the length of daylight.
- The relation of a person's shoe size to their height.
- The relation of amount of money earned and hours worked.

Function Notation

$$y = 3x + 2$$

$$f(x) = 3x + 2$$

Name of Function

Input

Output

Function Notation

- $p(t)$ for **power** at time t
- $f(t)$ for **force** at time t
- $h(x)$ for **height** of an object and x for horizontal units from a fixed point
- v for voltage
- s for speed
- The list is endless . . .

Evaluate the Function

To find f(-2) you need to substitute a -2 for every x value. Then carefully simplify using the order of operations.

Find f (-2).

$$f(x) = 2x^2 - 3x + 6$$

$$f(-2) = 2(-2)^2 - 3(-2) + 6$$

$$f(-2) = 2(4) - 3(-2) + 6 = 8 + 6 + 6 = 20$$

It's Your Turn!

Given f(x) = 3x + 20, find

f(-4)

= 3(-4) + 20

= -12 + 20

= 8

To find f(-4) you need to substitute a -4 for every x value. Then carefully simplify using the order of operations.

It's Your Turn!

Given that the height of a particular object at time 6 is: $h(t) = 50\,t - 4.9t^2$, find h(2)

$h(2) = 50(2) - 4.9(2)^2 = 100 - 19.6 = 80.4$

Resources

Functions – Khan Academy

https://www.khanacademy.org/math/algebra/algebra-functions

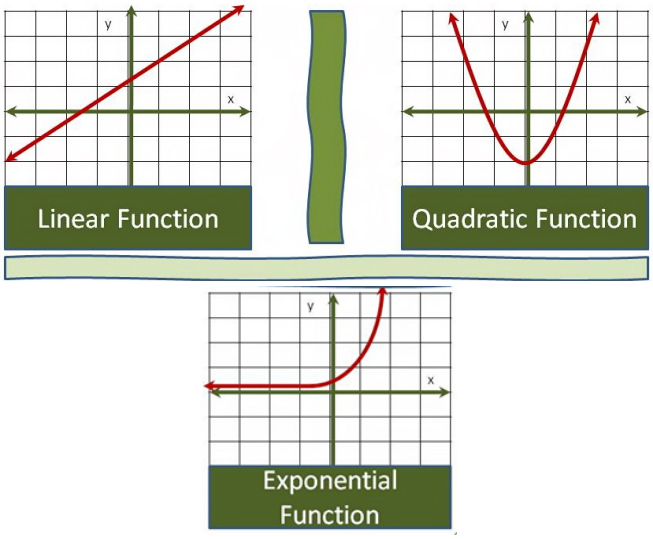
What is a function?

https://www.youtube.com/watch?v=ryQJa8ybxVY

Math is Fun

https://www.mathsisfun.com/sets/function.html

Types of Functions



Samples of Linear Functions

- The linear function F = 1.8C + 32 can be used to convert temperatures between Celsius and Fahrenheit.
- If a utility company charges a fixed monthly rate plus a constant rate for each unit of power consumed, a linear function will show the monthly cost of power. If the fixed rate is $25, and the cost for each unit of power is $0.02, the linear function is C = 0.02P + 25.
- The linear function I = 400C + 1,500 yields the total monthly income of a car salesman who makes a monthly base salary of $1,500 and receives $400 dollars for each car sold.

Linear Functions

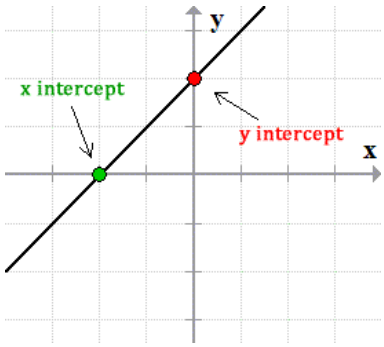
Form:	Standard Form	Point-Slope Form	Slope-Intercept Form
Equation:	$Ax + By = C$, where $A \neq 0$, $B \neq 0$	$y - y_1 = m(x - x_1)$, where $m \neq 0$	$y = mx + b$, where $m \neq 0$
Information:	x-intercept: $(\frac{C}{A}, 0)$ y-intercept: $(0, \frac{C}{B})$	Slope: m Point on the line: (x_1, y_1)	Slope: m y-intercept: (0, b)

A Real-World Linear Function

A lawyer charges a base (one time) fee of $200 and $75 each hour for consulting with her. Calculate the total cost of the lawyer if you consulted with her for one, two, three, four, or five hours.

Finding *x* and *y* Intercepts

The *x* intercept is where a function crosses the *x* axis, and the y intercept is where a function crosses the *y* axis.



What's slope got to do with it?

Slope-intercept is a "big" concept in algebra

- Slope or Rate of Change = rise/run = vertical change/horizontal change = change in y/change in x
- y = m*x* + b formula

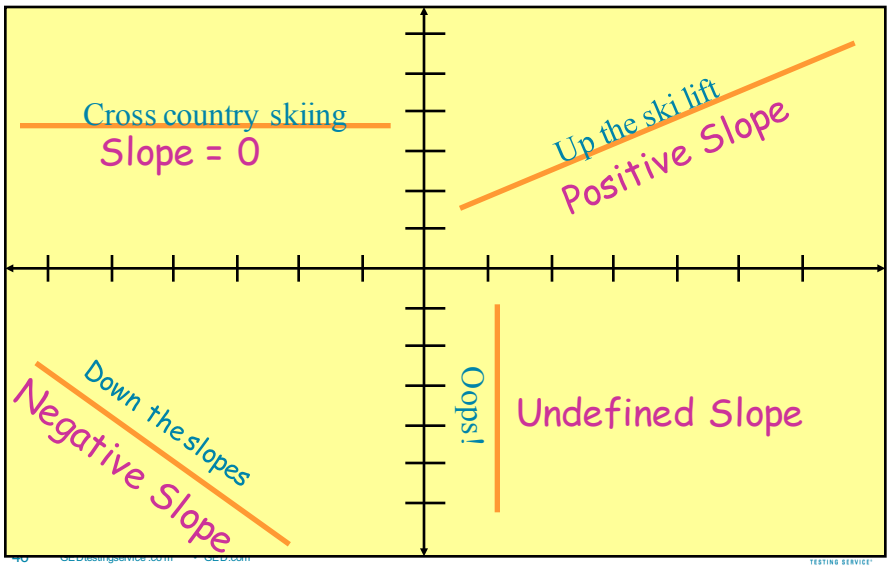
  x is the input

  y is the output

  m represents the slope

  b represents the *y* intercept

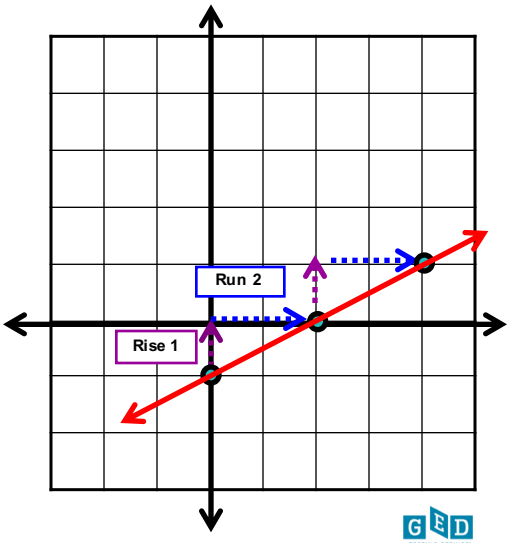
Types of Slopes



Graph Using Slope Intercept Form

y = ½ *x*-1

1. First, graph the y-intercept (b). In this equation, b= -1, so place a dot on the point (0,-1).
2. Next, use the slope (½) to rise up once and run twice horizontally. Plot the point.
3. Plot as many points as desired using the slope, then draw a line through the points.



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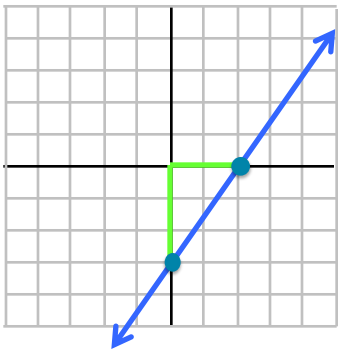
Equations of Lines

Slope-Intercept Form

m = slope of line *b = y-intercept*

$y = mx + b$

$$y = \frac{3}{2}x - 3$$



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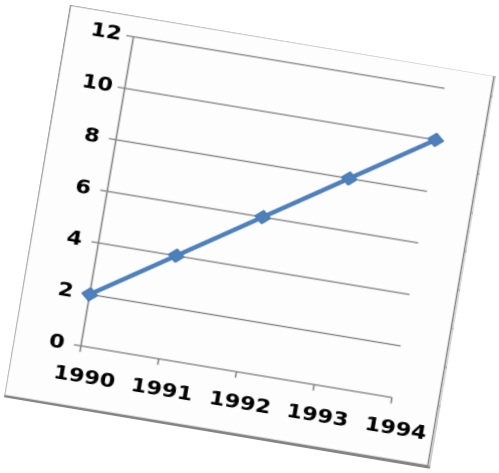
Example of Slope in a Real World Scenario

The graph shows the growth of a tree at a constant rate, over a period of four years.

m= Change in height / Change in time

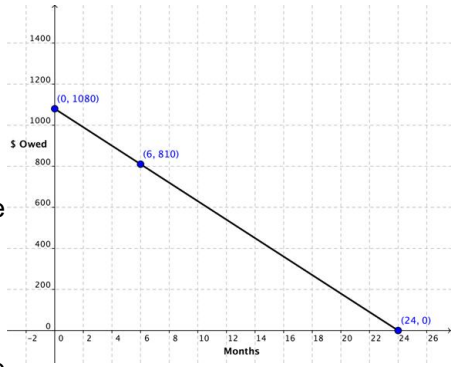


Example of y-Intercept in a Real World Scenario

The y-intercept in this graph is 1080, meaning it is the amount the person owes before he/she began making payments. (Zero payments have been made, $1080 owed.)

The graph then shows that over the next 24 months this debt will be paid off.

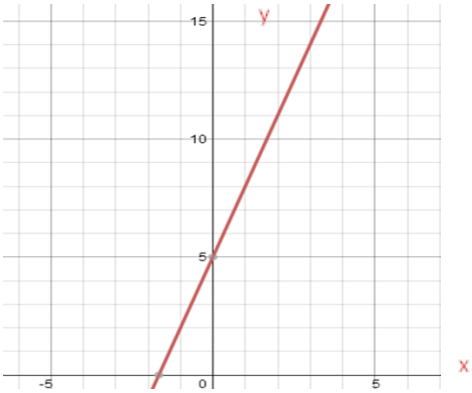
Word problems with linear equations usually work this way: the slope is the rate of change, and the *y*-intercept is the starting value.



Just a Quick Check

The graph shows the amount of money you have at the beginning of the month.

- How much money did you begin with?
- How much money do you earn each week?
- How much money will you have after 3 weeks?



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Sample GED® Items

Mathematical Reasoning - Candidate Name

Question 6 of 10

Answer Explanation | Calculator | Flag for Review

A scientist is studying red maple tree growth in a state park. She measured the trunk diameters of a sample of trees in the same month every other year. The tables show the data for two of the trees.

Tree 1

Year	Trunk Diameter (inches)
1	18.6
3	19.2
5	19.8
7	20.4
9	21.0
11	21.6
13	22.2

Tree 2

Year	Trunk Diameter (inches)
1	11.4
3	12.0
5	12.6
7	13.2
9	13.8
11	14.4
13	15.0

This is the final year in which she will collect data. When her data collection is complete, she will predict future red maple tree growth.

Formula Sheet | Calculator Reference

The scientist creates an equation that models her data for each tree so that she can predict the diameter in the future. Complete a linear equation that fits the data for tree 1, where x is the year and y is the trunk diameter, in inches.

Click on the variables and numbers you want to select and drag them into the boxes.

Equation for Tree 1

$y =$ ☐ ☐ + ☐

−0.6	−0.3	0.3	0.6
18.0	18.3	18.6	x

Previous | Next

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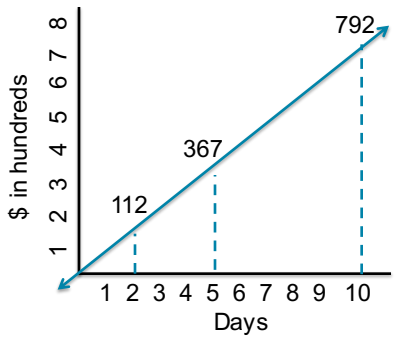
Remember Harley?

a) $m = \frac{367-112}{5-2} = \frac{255}{3} = 85$

b = 367 – 85(5) = -58

b) y = 85x – 58

c) y = 85(10) – 58 = 850 – 58 = $792



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Linear Equations/Functions

- Teach students to graph ordered pairs and determine the point of intersections
  - Graph a minimum of two points
  - Find the y-intercept
  - Determine the rate of change
- Teach students how to solve systems of equations by:
  - Graphing
  - Substitution
  - Elimination

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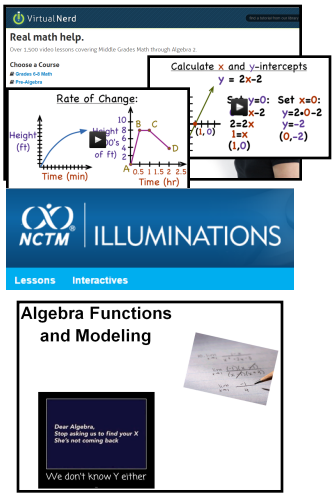
Resources



Virtual Nerd

http://www.virtualnerd.com/

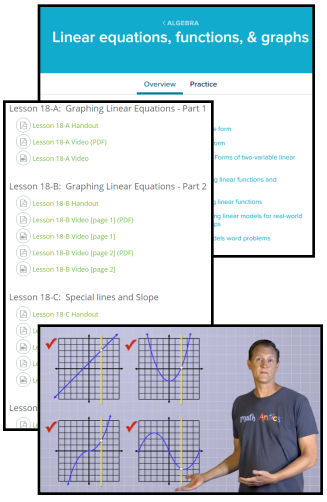
Illuminations

https://illuminations.nctm.org/

Algebraic Functions and Modeling – Steve Schmidt, Appalachian State

https://abspd.appstate.edu/node/385

Resources



Linear Equations, Functions, and Graphs – Khan Academy

https://www.khanacademy.org/math/algebra-home/alg-linear-eq-func

Beginning Algebra – IPDAE

http://www.floridaipdae.org/index.cfm?fuseaction=resources.GEDAHS&cagiid=DA077C783C76A85D93EE670F44851D4C70E44B31245B6D1B60A314A7FABD6FAE

What Are Functions? Math Antics

https://www.youtube.com/watch?v=52tpYl2tTqk

Remember

- Functions are not always linear
- Functions can be quadratic or exponential or a myriad of types
- It's how the notation is written
- For more . . .

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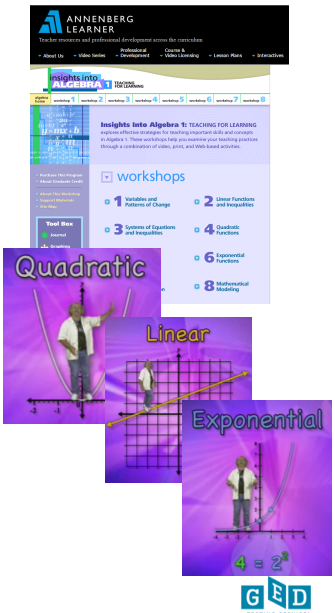
Resources

- Insights Into Algebra 1. The Annenberg Learner https://www.learner.org/workshops/algebra/index.html
- Properties of Functions. The Math Dude http://www.montgomeryschoolsmd.org/departments/itv/MathDude/watch-online.aspx?id=31



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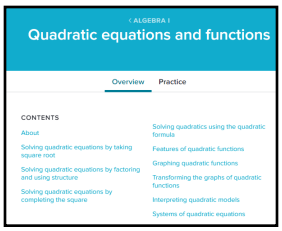
Resources



Khan Academy

https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions

https://www.khanacademy.org/math/algebra/quadratics#features-of-quadratic-functions

Inside Mathematics

http://www.insidemathematics.org/common-core-resources/mathematical-content-standards/standards-by-grade/high-school-functions

Tips for Teaching Functions

- Make it meaningful - start with concrete examples and real-world problems
- Make your thinking processes visible
- Solve the problems many ways
- Show the application
- Provide time for discourse - have students communicate their reasoning

Tuesdays for Teachers

Next Tuesdays for Teachers – April 25th

- More content-based information
- More strategies and activities
- More resources

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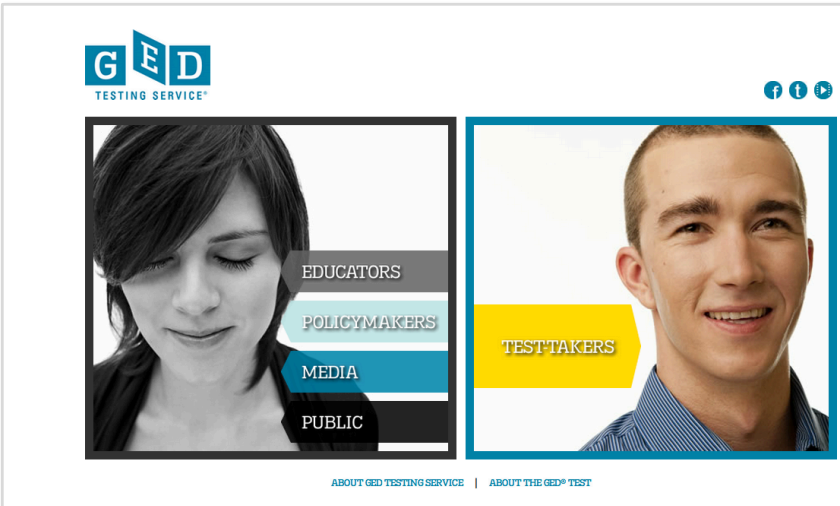

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Thank you!

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