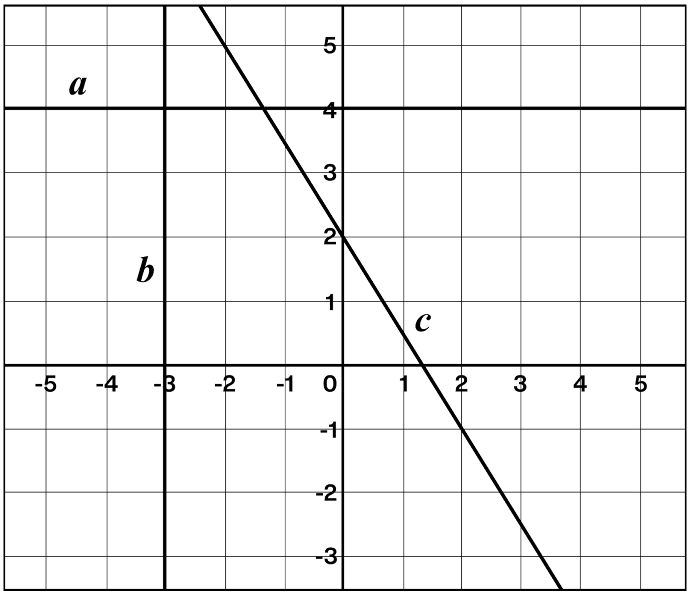
desmos Science Mom Lesson 63

Unit 8.3, Lesson 9: Notes Name ____________________

Learning Goal(s):



Here are three lines on a coordinate grid.

Write an equation for each line.

Line	Equation
a	
b	
c	

	Description	Graph	Slope	Equation
Horizontal Lines				
Vertical Lines				

Summary Question

Write an example of an equation for a . . .

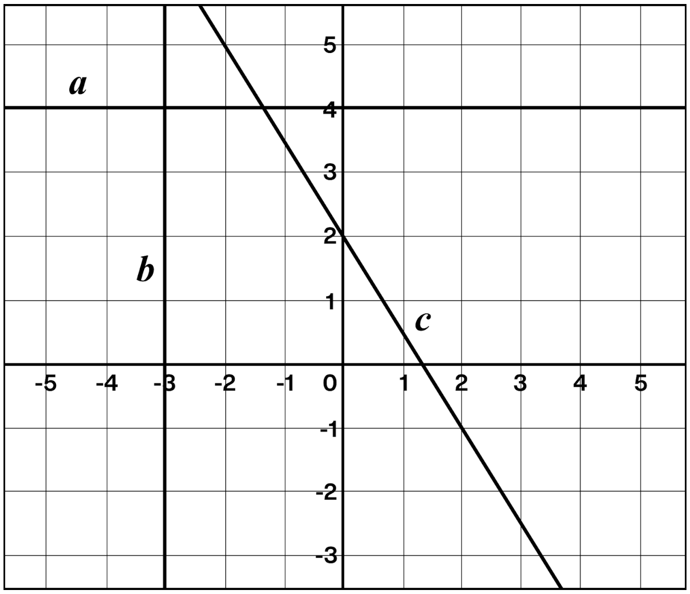
. . . horizontal line.

. . . vertical line.

. . . line with a negative slope.

Unit 8.3, Lesson 9: Notes Name ______________________________

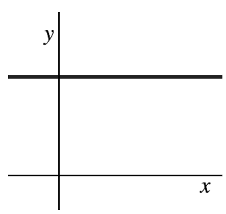
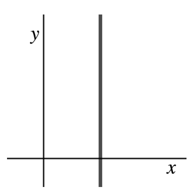
Learning Goal(s):
- **I can write equations of lines that have a positive or negative slope.**
- **I can write equations of vertical and horizontal lines.**



Here are three lines on a coordinate grid.

Write an equation for each line.

Line	Equation
a	$y = 4$
b	$x =- 3$
c	$y =- \frac{3}{2}x + 2$

	Description	Graph	Slope	Equation Example
Horizontal Lines	**Lines where the y-value does not change, while the x-value changes.**		**Since the y-value does not change, the slope is 0.**	$y = 10$
Vertical Lines	**Lines where the x-value does not change, while the y-value changes.**		**Since the x-value does not change, the slope is undefined.**	$x = 2$

Summary Question

Write an example of an equation for a . . .

. . . horizontal line.

Responses vary.

$y = 3$

. . . vertical line.

Responses vary.

$x = -8$

. . . line with a negative slope.

Responses vary.

$y =- 2x + 6$

desmos **Science Mom Lesson 64**

Unit 8.3, Lesson 10: Notes Name ______________________________________

Learning Goal(s):

Definition	Facts/Characteristics
Solution to an Equation With Two Variables	
Examples	Non-Examples

Here are some facts about solutions in two variables:

1. A solution to a linear equation is a pair of values that makes the equation ________ .
2. Solutions can be found by _______________________ a value for one of the variables and solving the equation for the other.
3. The set of all the solutions to a linear equation can be shown in the coordinate plane and is called the __________________ of the equation.
4. The graph of a linear equation is ____________________ .
5. Any points in the coordinate plane that **do not** lie on the graph of the linear equation are __________________________ to the equation.
6. The number of solutions might be limited in a real-world situation even though the equation has _________________________ solutions.

Summary Question

How can you find solutions to linear equations? How do you know when you've found a solution?

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Unit 8.3, Lesson 10: Notes Name ______________________

Learning Goal(s):

- **I know that the graph of an equation is a visual representation of all the solutions to the equation.**
- **I understand what the solution to an equation with two variables is.**

Solution to an Equation With Two Variables

Definition

Solutions are any pair of values that can be substituted in for the variables to make the equation true.

Facts/Characteristics

When graphed, solutions to an equation with two variables are points that are on the line representing the equation.

Examples

One solution to the equation $4x + 3y = 24$ **is** $(6, 0)$ **because** $4(6) + 3(0) = 24$**.**

Non-Examples

The point $(10, 0)$ **is not a solution to the equation** $4x + 3y = 24$ **because** $4(10) + 3(0) \neq 24$**.**

Here are some facts about solutions in two variables:

1. A solution to a linear equation is a pair of values that makes the equation **true**.
2. Solutions can be found by **substituting** a value for one of the variables and solving the equation for the other.
3. The set of all the solutions to a linear equation can be shown in the coordinate plane and is called the **graph** of the equation.
4. The graph of a linear equation is **a line** .
5. Any points in the coordinate plane that **do not** lie on the graph of the linear equation are **not solutions** to the equation.
6. The number of solutions might be limited in a real-world situation even though the equation has **infinite** solutions.

Summary Question

How can you find solutions to linear equations? How do you know when you've found a solution?

Solutions can be found by substituting a value for one of the variables and solving the equation for the other. You know you've found a solution when the point lies on the graph of the equation.

Unit 8.3, Lesson 11: Notes Name ________________________________

Learning Goal(s):

No matter the form of a linear equation, we can always find solutions to the equation by starting with one value and then solving for the other value.

Let's think about the linear equation $2x - 4y = 12$.

Find the y-intercept by making $x = 0$.	Find the x-intercept by making $y = 0$.
Based on your work above, what are the coordinates of two points on the line $2x - 4y = 12$?	

Summary Question

Once you have identified one solution to your equation, what are some ways you can find others?

Unit 8.3, Lesson 11: Notes Name ____________________________________

Learning Goal(s):

- **I can find solutions to linear equations given either the x- value or the y-value.**
- **I can write linear equations to reason about real-world situations.**

No matter the form of a linear equation, we can always find solutions to the equation by starting with one value and then solving for the other value.

Let's think about the linear equation $2x - 4y = 12$.

Find the y-intercept by making $x = 0$.	Find the x-intercept by making $y = 0$.
$2x - 4y = 12$ $2(0) - 4y = 12$ $0 - 4y = 12$ $-4y = 12$ $y = -3$	$2x - 4y = 12$ $2x - 4(0) = 12$ $2x - 0 = 12$ $2x = 12$ $x = 6$

Based on your work above, what are the coordinates of two points on the line $2x - 4y = 12$?

The points $(0, -3)$ and $(6, 0)$ lie on the graph of the line $2x - 4y = 12$.

Summary Question

Once you have identified one solution to your equation, what are some ways you can find others?

You can find solutions to linear equations by:

- **Graphing the line and finding the coordinates of additional points on the line.**
- **Substituting a value for one of the variables and solving the equation for the other.**

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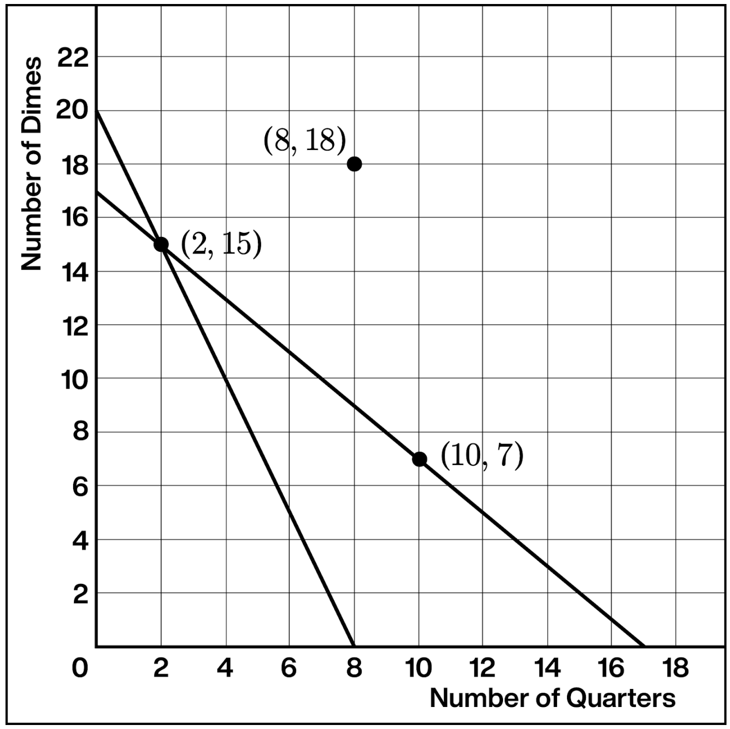
Unit 8.4, Lesson 9: Notes Name ______________________________

Learning Goal(s):



Values of x and y that make an equation ________ correspond to points (x, y) on the graph. For example, if we have x number of quarters and y number of dimes and the total cost is $\$2.00$, then we can write an equation like this to represent the relationship between x and y: $0.25x + 0.10y = 2$.

Since 2 quarters is \$_______ and 15 dimes is \$_______, we know that $x = 2$, $y = 15$ is a _______________ to the equation, and the point (___, ___) is a point on the graph. The line shown is the graph of the equation.

We also know that the quarters and dimes together total 17 coins. That means that : $x + y = 17$

1. Label the graph of each equation on the coordinate plane.

2. Pick another point on the coordinate plane and explain what it means in context:

In general, if we have two lines in the coordinate plane:

- The coordinates of a point that is on both lines make _______________ equations true.
- The coordinates of a point on only one line make _______________ equation true.
- The coordinates of a point on neither line make _______________ equation true.

Summary Question

If you are given two linear relationships, how can you determine x- and y-values that will make both relationships true?

Unit 8.4, Lesson 9: Notes Name ______________________

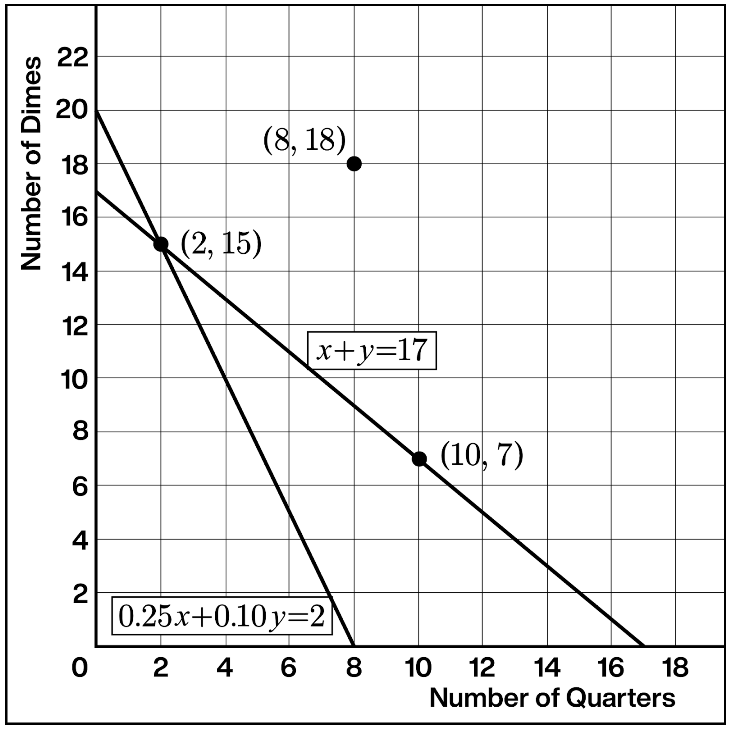
Learning Goal(s):

- **I can identify and interpret points that satisfy two relationships at the same time using graphs.**

Values of x and y that make an equation **true** correspond to points (x, y) on the graph. For example, if we have x number of quarters and y number of dimes, and the total cost is $\$2.00$, then we can write an equation like this to represent the relationship between x and y: $0.25x + 0.10y = 2$.

Since 2 quarters is $\$0.50$ and 15 dimes is $\$1.50$, we know that $x = 2$, $y = 15$ is a **solution** to the equation, and the point $(2, 15)$ is a point on the graph. The line shown is the graph of the equation.

We also know that the quarters and dimes together total 17 coins. That means that: $x + y = 17$



1. Label the graph of each equation on the coordinate plane.

2. Pick another point on the coordinate plane and explain what it means in context:
   Responses vary. **The point $(10, 7)$ means there are 10 quarters and 7 dimes totaling 17 coins.**

In general, if we have two lines in the coordinate plane:

- The coordinates of a point that is on both lines make **both** equations true.
- The coordinates of a point on only one line make **one** equation true.
- The coordinates of a point on neither line make **neither** equation true.

Summary Question

If you are given two linear relationships, how can you determine x- and y-values that will make both relationships true?

Responses vary. **By looking at the graph of the two linear relationships, the ordered pair that falls on both lines will make both relationships true.**

desmos **Science Mom Lesson 67**

Unit 8.4, Lesson 10: Notes Name ___________________________________

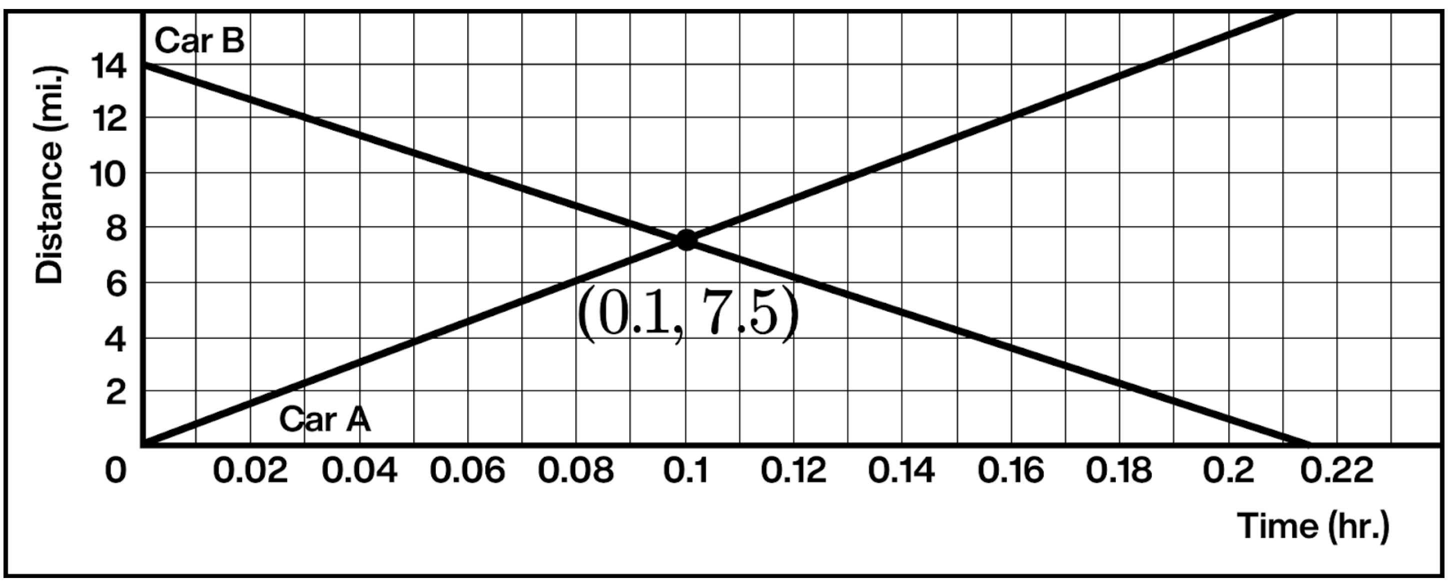
Learning Goal(s):

The solutions to an equation correspond to ____________ on its graph. For example, if Car A is traveling 75 miles per hour and passes a rest area when $t = 0$, then the distance in miles it has traveled from the rest area after t hours can be represented by the equation ________________.

1. What is one point that will be on this graph? How do you know?

If you have **two** equations, you can ask whether there is an ordered pair that is a solution to both equations simultaneously.

For example, if Car B is traveling toward the rest area and its distance from the rest area is $d = 14 - 65t$, we can ask if there is ever a time when the distance of Car A from the rest area is the same as the distance of Car B from the rest area. If the answer is yes, then the solution will correspond to a point _________________________________.



Looking at the coordinates of the intersection point, we see that Car A and Car B will both be _________ miles from the rest area after _________ hours.

Summary Question

How can you tell by looking at a graph when two linear relationships will be the same?

Unit 8.4, Lesson 10: Notes Name ________________________________

Learning Goal(s):

- **I can use graphs to find an ordered pair that two real-world situations have in common.**

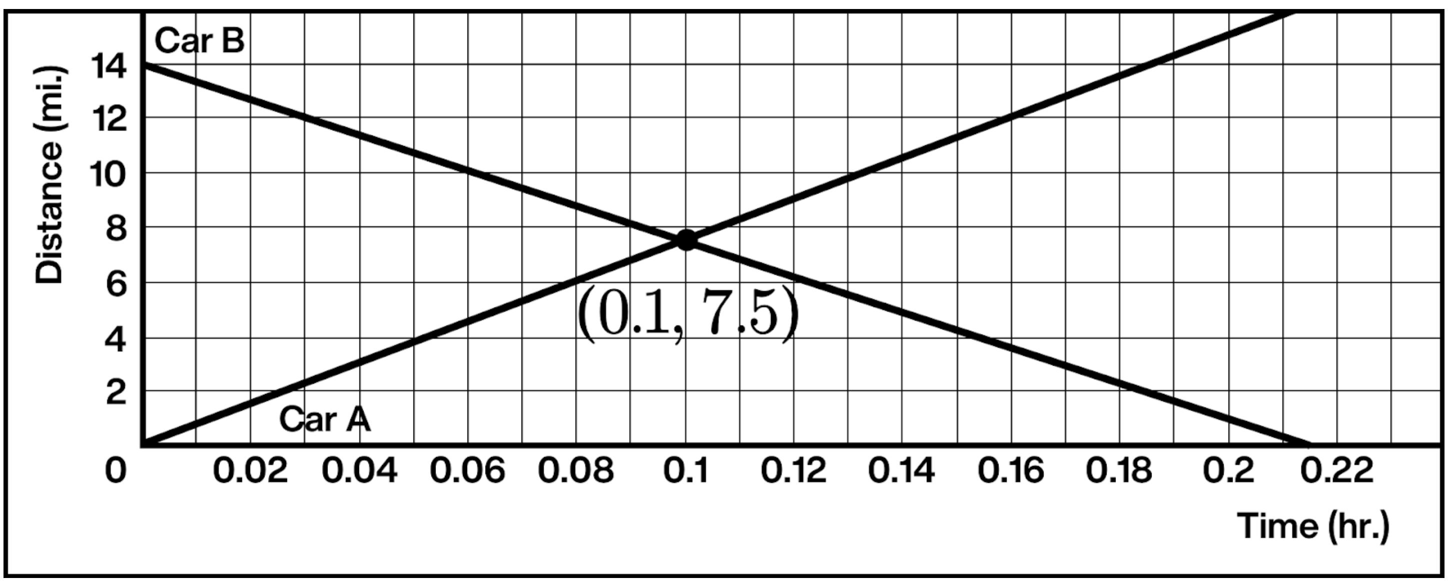
The solutions to an equation correspond to **points** on its graph. For example, if Car A is traveling 75 miles per hour and passes a rest area when $t = 0$, then the distance in miles it has traveled from the rest area after t hours can be represented by the equation $d = 75t$.

1. What is one point that will be on this graph? How do you know?

   Responses vary. **The point $(2,\ 150)$ will be on the graph of this equation because $150 = 75 \cdot 2$. 2 hours after passing the rest area, the car has traveled 150 miles.**

If you have **two** equations, you can ask whether there is an ordered pair that is a solution to both equations simultaneously.

For example, if Car B is traveling towards the rest area and its distance from the rest area is $d = 14 - 65t$, we can ask if there is ever a time when the distance of Car A from the rest area is the same as the distance of Car B from the rest area. If the answer is yes, then the solution will correspond to a point **that is on both lines**.



Looking at the coordinates of the intersection point, we see that Car A and Car B will both be 7.5 miles from the rest area after 0.1 hours.

Summary Question

How can you tell when two linear relationships will be the same?

You can determine when two linear relationships will be the same by graphing both on the same coordinate plane and finding their point of intersection.

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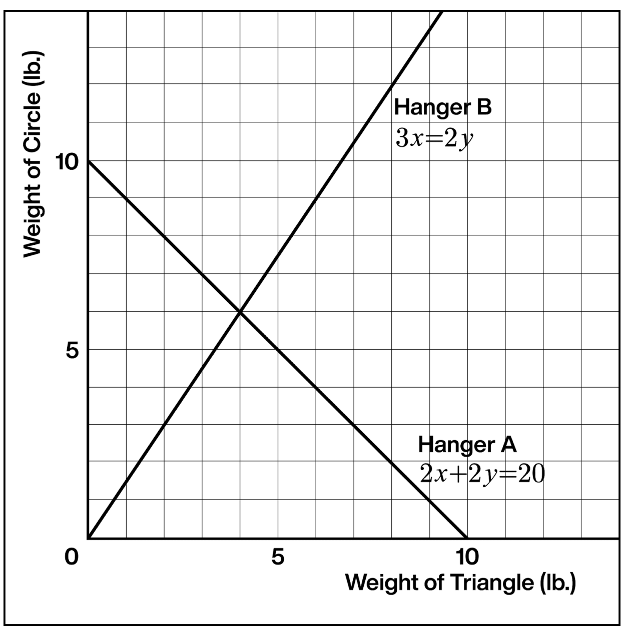
Unit 8.4, Lesson 11: Notes Name ____________________________

Learning Goal(s):

Definition	Facts/Characteristics
System of Equations	
Examples	Non-Examples

The system of equations below represents the weights of two balanced hangers.



What is the solution to the system of equations?

What does the solution tell us about the hangers?

Summary Question

What does it mean to solve a system of equations?

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Unit 8.4, Lesson 11: Notes Name ________________________________

Learning Goal(s):
- **I can explain the solution to a system of equations in a real-world context.**
- **I can explain what a system of equations is.**
- **I can make graphs to find an ordered pair that two real-world situations have in common.**

System of Equations

Definition

A system of equations is a set of two or more equations.

Facts/Characteristics

Each equation contains two or more variables. We want to find values for the variables that make all the equations true.

Examples

These equations make up a system of equations:

$$\begin{cases} x+y=-2 \\ x-y=12 \end{cases}$$

The solution to this system is $x=5$ and $y=-7$ because when these values are substituted for x and y, each equation is true: $5+(-7)=-2$ and $5-(-7)=12$

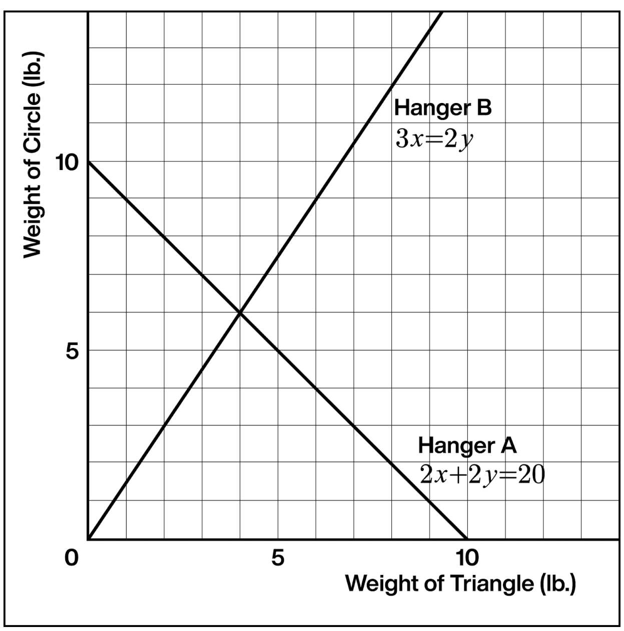
Non-Examples

10

$3x+15$

$y=4x+7$

The system of equations below represents the weights of two balanced hangers.



What is the solution to the system of equations?

$(4,\ 6)$

What does the solution tell us about the hangers?

The hanger will balance when the triangles weigh 4 lb. and the circles weigh 6 lb.

Summary Question

What does it mean to solve a system of equations?

Solving a system of equations means finding the values of the variables that make each equation true.

desmos Science Mom Lesson 69

Unit 8.4, Lesson 12: Notes Name ___________________________________

Learning Goal(s):

Sometimes it is easier to solve a system of equations without having to graph the equations and look for an ______________ ________.

In general, whenever we are solving a system of equations we know that we are looking for a pair of (x, y) values that makes both equations _________. In particular, we know that the value for y will be the _________ in both equations.

If we have a system like this: $$y = 2x + 6$$ $$y = -3x - 4$$ we know the ___________ of the solution is the same in both equations, so we can write the following: $$2x + 6 = -3x - 4$$ and we can solve this equation for x: $$2x + 6 = -3x - 4$$	Solving for x is only half of what we are looking for; we know the value for x, but we need the corresponding value for y. Since both equations have the same y-value, we can use either equation to find the y-value: $$y = 2(-2) + 6$$ $$y = -3(-2) - 4$$ In both cases, we find that $y = 2$. So the solution to the system is ________. We can verify this by graphing both equations in the coordinate plane.

Summary Question

What are the first steps you can take when solving the following system of equations?

$$y = 2x$$
$$y = -3x + 10$$

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Unit 8.4, Lesson 12: Notes Name ________________________________

Learning Goal(s): ● **I can solve systems of equations using algebra.**

Sometimes it is easier to solve a system of equations without having to graph the equations and look for an **intersection point.**

In general, whenever we are solving a system of equations we know that we are looking for a pair of (x, y) values that makes both equations **true**. In particular, we know that the value for y will be the **same** in both equations.

If we have a system like this: $y = 2x + 6$ $y = -3x - 4$ we know the y **-value** of the solution is the same in both equations, so we can write the following: $2x + 6 = -3x - 4$ and we can solve this equation for x: $2x + 6 = -3x - 4$ $5x + 6 = -4$ $5x = -10$ $x = -2$	Solving for x is only half of what we are looking for; we know the value for x, but we need the corresponding value for y. Since both equations have the same y-value, we can use either equation to find the y-value: $y = 2(-2) + 6$ $y = -3(-2) - 4$ In both cases, we find that $y = 2$. So the solution to the system is $(-2, 2)$. We can verify this by graphing both equations in the coordinate plane.

Summary Question

What are the first steps you can take when solving the system of equations?

$$y = 2x$$
$$y = -3x + 10$$

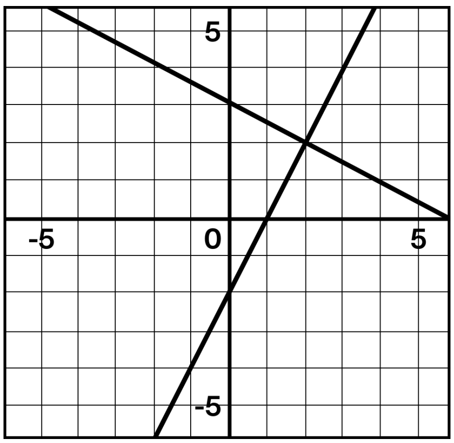
Since I know the y-value is the same in both equations, I can write $2x = -3x + 10$. Then I can use balancing moves to get all of the variables on one side of the equation.

desmos **Science Mom Lesson 70**

Unit 8.4, Lesson 13: Notes Name ______________________________

Learning Goal(s):

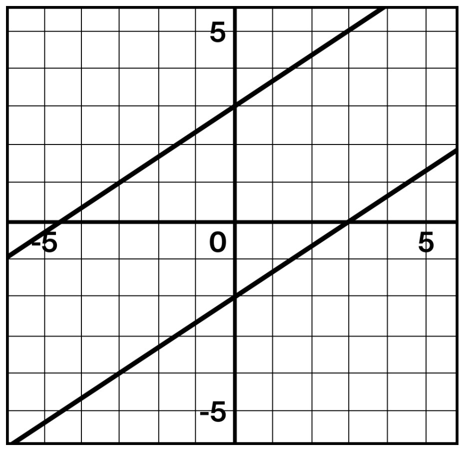
The x- and y- values that make both equations true are known as the ________________ to a system of equations. Depending on the equations, a system can have ________________, ________________, or ________________ solutions.



$$y = 2x - 2$$
$$y = -\frac{1}{2}x + 3$$

If the two lines of a system intersect at a point, there is ______________ solution.

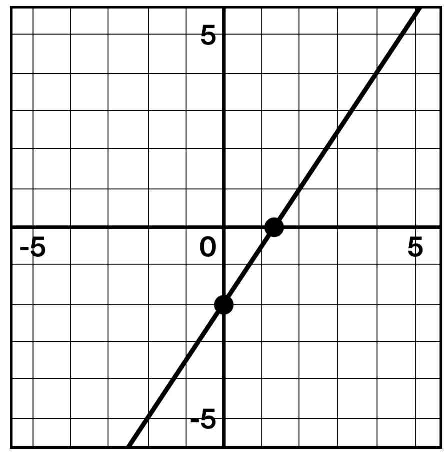
If the two lines have ________________ slopes, there is one solution.



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

If the two lines of a system **do not** intersect at a point, there are ____________ solutions.

If the two lines have ___________ slope and different y-intercepts, there are no solutions.



$$y = 1.5x - 2$$
$$y = \frac{3}{2}x - 2$$

If the two equations have the **same** slope and the **same** y-intercept, the system has ________________ solutions.

Summary Question

How can you tell from the structure of the equations if a system has no solutions, one solution, or infinite solutions?

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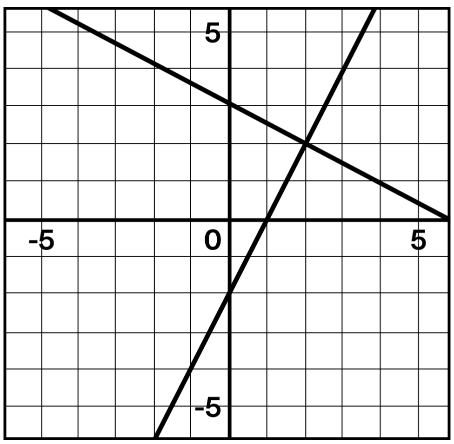
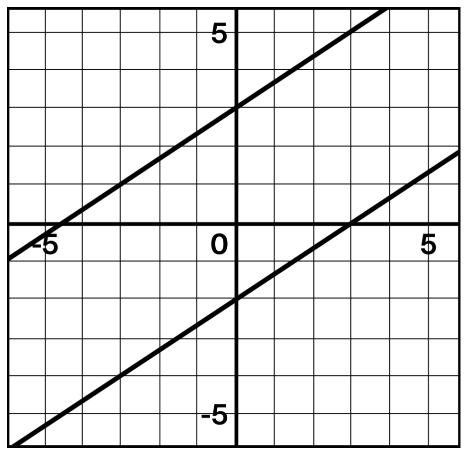
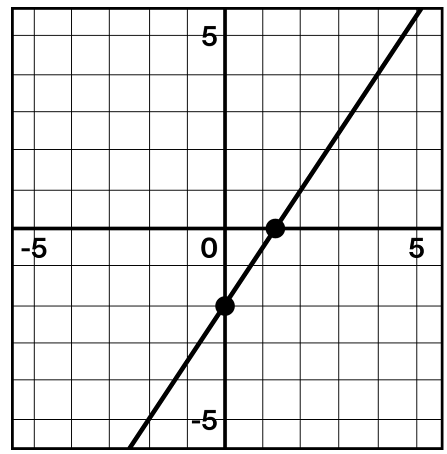
Unit 8.4, Lesson 13: Notes Name ______________________

Learning Goal(s):   • **I can determine whether a system of equations has no solutions, one solution, or infinitely many solutions.**

The x- and y-values that make both equations true are known as the **solution** to a system of equations. Depending on the equations, a system can have **no solutions**, **one solution**, or **infinitely many** solutions.

		
$y = 2x - 2$ $y = -\frac{1}{2}x + 3$	$y = \frac{2}{3}x - 2$ $y = \frac{2}{3}x + 3$	$y = 1.5x - 2$ $y = \frac{3}{2}x - 2$
If the two lines of a system intersect at a point, there is **one** solution. If the two lines have **different** slopes, there is one solution.	If the two lines of a system **do not** intersect at a point, there are **no** solutions. If the two lines have **the same** slope and different y-intercepts, there are no solutions.	If the two equations have the **same** slope and the **same** y-intercept, the system has **infinite** solutions.

Summary Question
How can you tell from the structure of the equations if a system has no solutions, one solution, or infinite solutions?

If the two equations have different slopes, there is one solution. If the two equations have the same slope but different y-intercepts, there are no solutions. If the two equations have the same slope and the same y-intercept, there are infinitely many solutions.

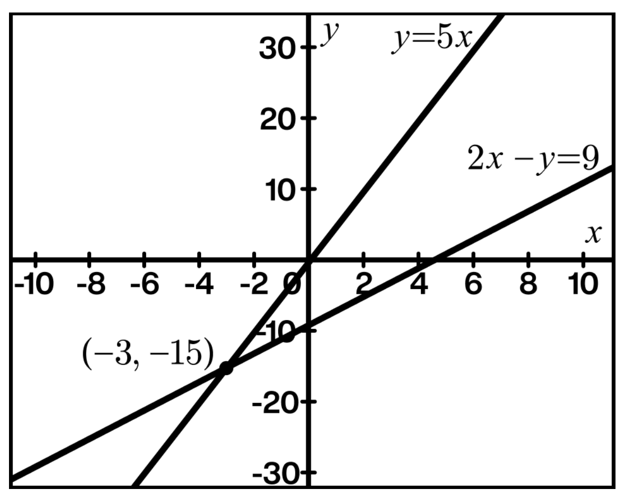
Unit 8.4, Lesson 14: Notes Name ___________________________

Learning Goal(s):

When we have a system of linear equations where one of the equations is of the form $y = [stuff]$ or $x = [stuff]$, we can solve it algebraically by using ____________. The basic idea is to replace a variable with an equivalent __________.	$\begin{cases} y=5x \\ 2x-y=9 \end{cases}$
Since $y = 5x$, we can substitute ______ for y in $2x - y = 9$.	$2x - (\quad) = 9$
And then solve the equation for x.	$x =$
We can calculate y using either equation. Let's use the first one:	$y = 5x$ $y = 5 \cdot$ ____ $y =$ _____
The x- and y-values that make both equations true are known as the ______________ to the system.	Solution $(-3,$ _____ $)$

We can check this by looking at the graphs of the equations in the system:

They intersect at $(-3, -15)$.



Summary Question

Describe one strategy you can use for solving a system of equations algebraically.

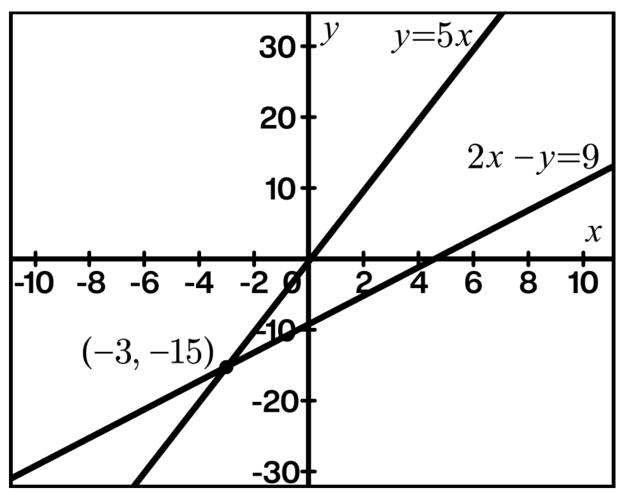
Unit 8.4, Lesson 14: Notes Name ________________________________

Learning Goal(s):
- **I can solve systems of equations using a variety of strategies.**

When we have a system of linear equations where one of the equations is of the form $y = [stuff]$ or $x = [stuff]$, we can solve it algebraically by using **substitution**. The basic idea is to replace a variable with an equivalent **expression**.	$\begin{cases} y=5x \\ 2x-y=9 \end{cases}$
Since we know that $y = 5x$, we can substitute ***5x*** for y in $2x - y = 9$.	$2x - (\ 5x\ ) = 9$
And then solve the equation for x.	$-3x = 9$ $x = -3$
We can find y using either equation. Let's use the first one:	$y = 5x$ $y = 5 \cdot -3$ $y = -15$
The x- and y-values that make both equations true are known as the **solution** to the system.	Solution $(-3, \ -15)$

We can check this by looking at the graphs of the equations in the system:

They intersect at $(-3, -15)$.



Summary Question
Describe one strategy you can use for solving a system of equations algebraically.

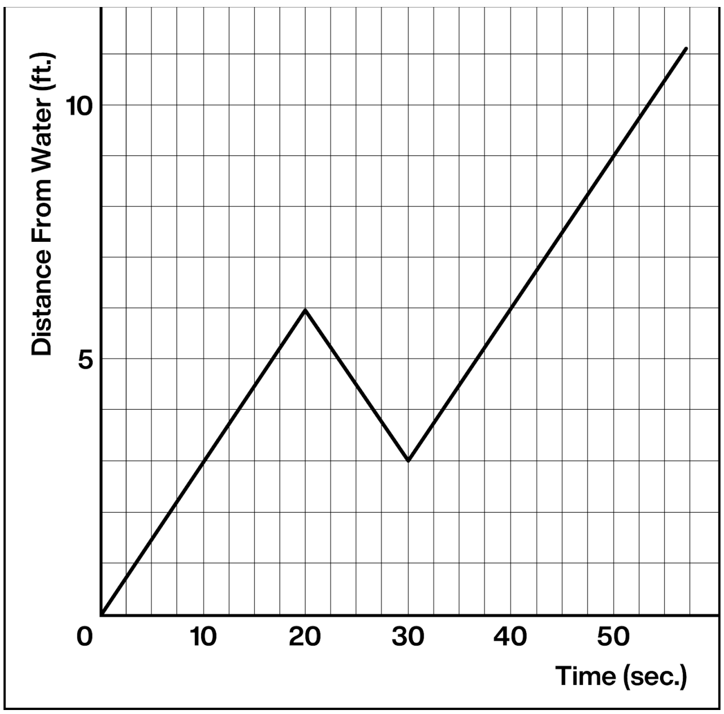
We can use substitution to solve a system of equations. In one equation, when a variable is equal to an expression, we can replace that variable with the expression in a different equation.

Unit 8.5, Lesson 1: Notes Name ___________________________________

Making Sense of Graphs

Learning Goal(s):

Here is the graph of a turtle's journey.

	What story does the graph tell about the turtle's journey?
What is the turtle's distance from the water after 40 seconds?	When is the turtle's distance from the water 3 feet?

Summary Question

How does a point on a graph represent part of a story? Give at least one example.

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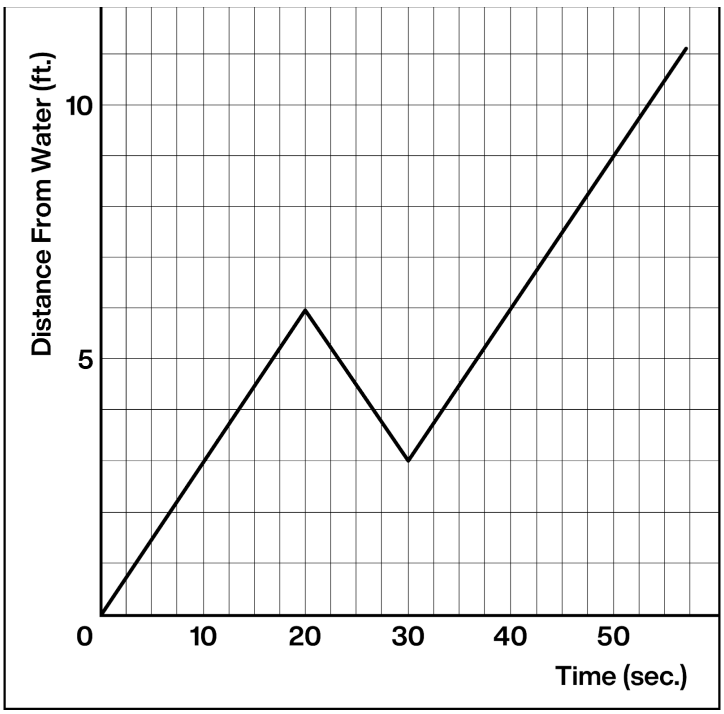
Unit 8.5, Lesson 1: Notes Name ______________________________

Making Sense of Graphs

Learning Goal(s): ● **I can make connections between scenarios and the graphs that represent them.**

Here is the graph of a turtle's journey.



What story does the graph tell about the turtle's journey?

The turtle started at the water and traveled away from the water for 20 seconds. Then it walked backwards towards the water. At 30 seconds, the turtle began to walk away from the water again.

What is the turtle's distance from the water after 40 seconds?

After 40 seconds, the turtle is 6 feet away from the water.

When is the turtle's distance from the water 3 feet?

The turtle's distance from the water is 3 feet at both 10 seconds and 30 seconds.

Summary Question

How does a point on a graph represent part of a story? Give at least one example.

A point on a graph can represent part of a story because it represents a point in time. For example, in the story of the turtle, the point $(10, 3)$ says that the turtle is 3 feet from the water after traveling for 10 seconds.

Unit 8.5, Lesson 2: Notes Name ____________________________________

Introduction to Functions

Learning Goal(s):

Definition	Facts/Characteristics
Function	
Examples	Non-Examples

For each rule, decide if the rule represents a function or not. Explain your thinking.

Possible Inputs: Any person Rule: Output the month the person was born in. Function? Yes No	Possible Inputs: Any month Rule: Output a person born in that month. Function? Yes No

Summary Question

Why might it be useful to know whether a rule is a function?

desmos

Unit 8.5, Lesson 2: Notes Name ______________________

Introduction to Functions

Learning Goal(s):

- **I can write rules when I know input-output pairs.**
- **I know that a function is a rule with exactly one output for each allowable input.**
- **I can identify rules that do and do not represent functions.**

Function

Definition	Facts/Characteristics
A function is a rule that assigns exactly one output to each possible input.	**In a table, you will never see one input with multiple different outputs.**
Examples	**Non-Examples**
Name → First Letter (e.g. Sarah → S) **Number → 7 (e.g., 5→ 7)**	**First Letter → Name (e.g., S→ Sarah)** **Digit → Number starting with that digit (e.g., 7→ 704)**

For each rule, decide if the rule represents a function or not. Explain your thinking.

Possible Inputs: Any person Rule: Output the month the person was born in. Function? **Yes** No **Each person is only born in one month, so each possible input has only one output.**	Possible Inputs: Any month Rule: Output a person born in that month. Function? Yes **No** **Each month has many people born in that month, so each input has many possible outputs.**

Summary Question

Why might it be useful to know whether a rule is a function?

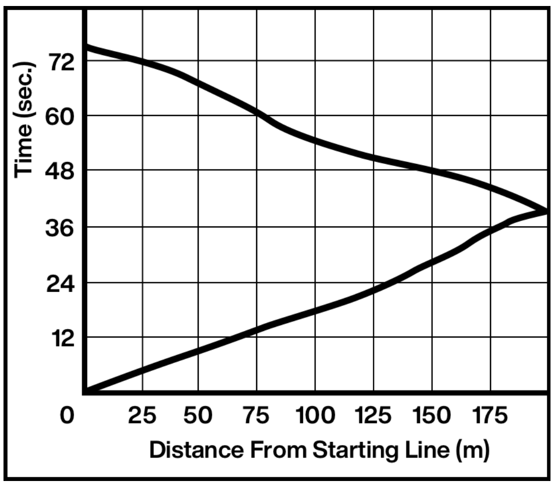
Knowing a rule is a function can be useful because functions are predictable in a specific way. You can know that for any input-output pair, there are no other possible outputs for that input.

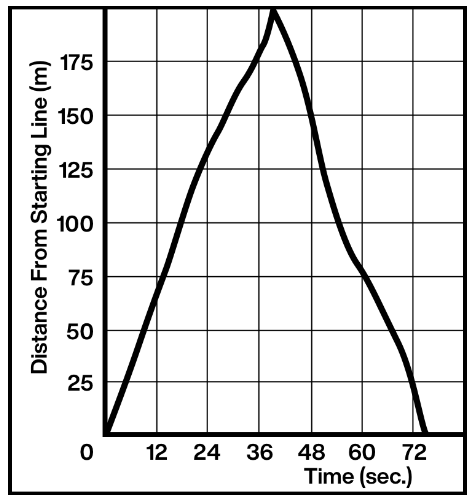
Unit 8.5, Lesson 3: Notes Name ____________________________________

Graphs of Functions and Non-Functions

Learning Goal(s):

Ariana is running once around the track. The graphs below show the relationship between her time and her distance from the starting point.





Estimate when Ariana was 100 meters from her starting point.	Estimate how far Ariana was from the starting line after 60 seconds.
Is time a function of Ariana's distance from the starting point? Explain how you know.	Is Ariana's distance from the starting point a function of time? Explain how you know.

Summary Question

What is something you won't see on the graph of a function?

desmos

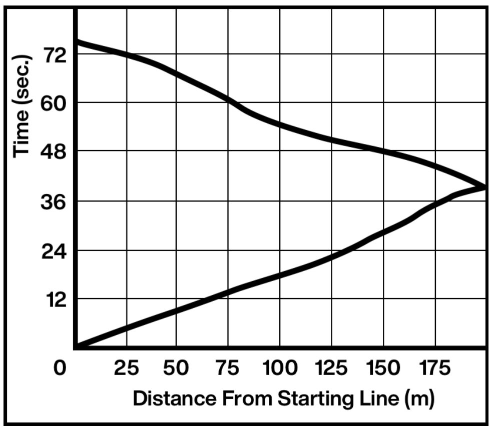
Unit 8.5, Lesson 3: Notes Name ____________________________________

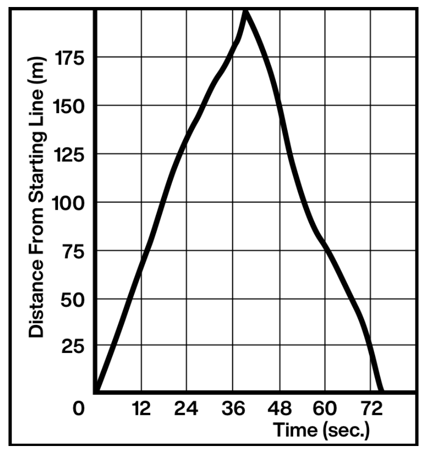
Graphs of Functions and Non-Functions

Learning Goal(s):

- **I can explain why a graph does or does not represent a function.**
- **I can use precise language to describe functions (e.g., "is a function of" or "determines").**

Ariana is running once around the track. The graphs below show the relationship between her time and her distance from the starting point.





Estimate when Ariana was 100 meters from her starting point. **After about 18 seconds and 54 seconds.**	Estimate how far Ariana was from the starting line after 60 seconds. **About 75 meters from the starting line.**
Is time a function of Ariana's distance from the starting point? Explain how you know. **No. Time is not a function of distance from the starting point because there are some distances (like 100 meters) that correspond with more than one time (18 and 54 seconds).**	Is Ariana's distance from the starting point a function of time? Explain how you know. **Yes. Distance from the starting point is a function of time because every time corresponds to only one distance.**

Summary Question
What is something you won't see on the graph of a function?

On the graph of a function, you won't see any x-values that corresponds to multiple y-values. For example, you would never see both the points $(0, 7)$ and $(0, 5)$ on the graph of a function because then one input would have two outputs.

Unit 8.5, Lesson 4: Notes Name ___________________________

Functions and Equations

Learning Goal(s):

In each situation, complete the table with a possible *independent variable* or *dependent variable.*

Question or Equation	Independent Variable	Dependent Variable
How many pickles can I make?	The number of cucumbers	The number of pickles
How much does my ice cream cost if I get different amounts of toppings?		Cost of my ice cream cone
How does sleep affect performance on tests?		
$y = 3x + 5$		

What is the *independent variable*? How is it represented on a graph?

What is the *dependent variable*? How is it represented on a graph?

Brown rice costs \$2 per pound and beans cost \$1.60 per pound. Rudra has \$10 to spend on these items. The amount of brown rice, r, is related to the amount of beans, b, Rudra can buy.

Rudra wrote the equation $r = \frac{10-1.60b}{2}$. What is the dependent variable? How do you know?

Summary Question
How does the choice of independent and dependent variables affect the equation of a function?

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Unit 8.5, Lesson 4: Notes Name ____________________

Functions and Equations

Learning Goal(s):

- **I can represent a function with an equation.**
- **I can name the independent and dependent variables for a function.**

In each situation, complete the table with a possible *independent variable* or *dependent variable.*

Question or Equation	Independent Variable	Dependent Variable
How many pickles can I make?	The number of cucumbers	The number of pickles
How much does my ice cream cost if I get different amounts of toppings?	**Number of toppings**	Cost of my ice cream cone
How does hours of sleep affect performance on tests?	**Hours of sleep**	**Test score**
$y = 3x + 5$	x	y

What is the *independent variable*? How is it represented on a graph? ***Responses vary.***

The independent variable is the input in a function. It is what is affecting the other variable. The independent variable is represented on the horizontal or x-axis of a graph.

What is the *dependent variable*? How is it represented on a graph? ***Responses vary.***

The dependent variable is the output in a function. It is what is affected by the other variable. The dependent variable is represented on the vertical or y-axis on a graph.

Brown rice costs \$2 per pound and beans cost \$1.60 per pound. Rudra has \$10 to spend on these items. The amount of brown rice, r, is related to the amount of beans, b, Rudra can buy.

Rudra wrote the equation $r = \frac{10-1.60b}{2}$. What is the dependent variable? How do you know?

The dependent variable is r (the amount of rice Rudra can buy). The equation is solved for r, so it is easiest to calculate the amount of rice needed based on the amount of beans Rudra buys.

Summary Question

How does the choice of independent and dependent variables affect the equation of a function?

Depending on the choice of variables, the format of the equation can change. Equations can be very useful when they are solved for the dependent variable (e.g., $r =$ when trying to answer questions about how much rice Rudra can buy).

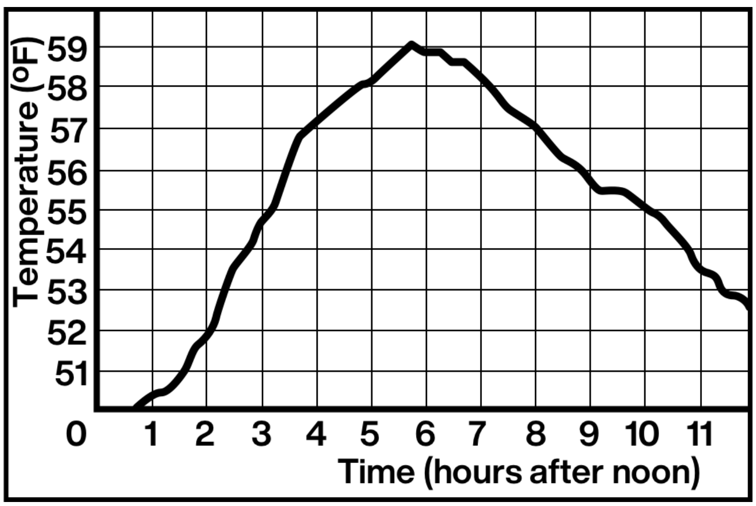
desmos **Science Mom Lesson 76**

Unit 8.5, Lesson 5: Notes Name ______________________________

Interpreting Graphs of Functions

Learning Goal(s):

This graph shows the temperature between noon and midnight on one day.



Tell the story of the temperature on this day.

Did the temperature change more between 1 p.m. and 3 p.m. or between 7 p.m. and 9 p.m.? Explain your thinking.

Was it warmer at 3 p.m. or 9 p.m.?

Summary Question

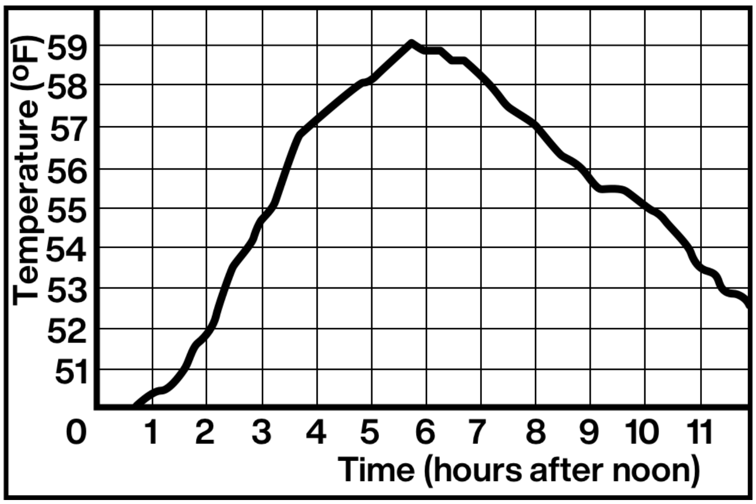
How can you tell from a graph whether a function is increasing or decreasing?

Unit 8.5, Lesson 5: Notes Name ______________________________

Interpreting Graphs of Functions

Learning Goal(s):
- **I can explain the story told by the graph of a function.**
- **I can find and interpret points on the graph of a function.**
- **I can determine whether a function is increasing or decreasing based on whether its rate of change is positive or negative.**

This graph shows the temperature between noon and midnight on one day.

	Tell the story of the temperature on this day. **The temperature starts cold (around $50°$ F) and then begins to get warmer throughout the day. The temperature is hottest between 5 p.m. and 6 p.m. Then the temperature decreases at a slower rate than it increased earlier in the day.**
Did the temperature change more between 1 p.m. and 3 p.m. or between 7 p.m. and 9 p.m.? Explain your thinking. **The temperature changed more between 1 p.m. and 3 p.m. (about 4.5°F) than between 7 p.m. and 9 p.m. (about 2.5°F).**	Was it warmer at 3 p.m. or 9 p.m.? **The temperature is higher at 9 p.m. than at 3 p.m.**

Summary Question

How can you tell from a graph whether a function is increasing or decreasing?

In a graph, if the line is going up as the x-values get larger, then the function is increasing. If the line is going down as the x-values get larger, then the function is decreasing.

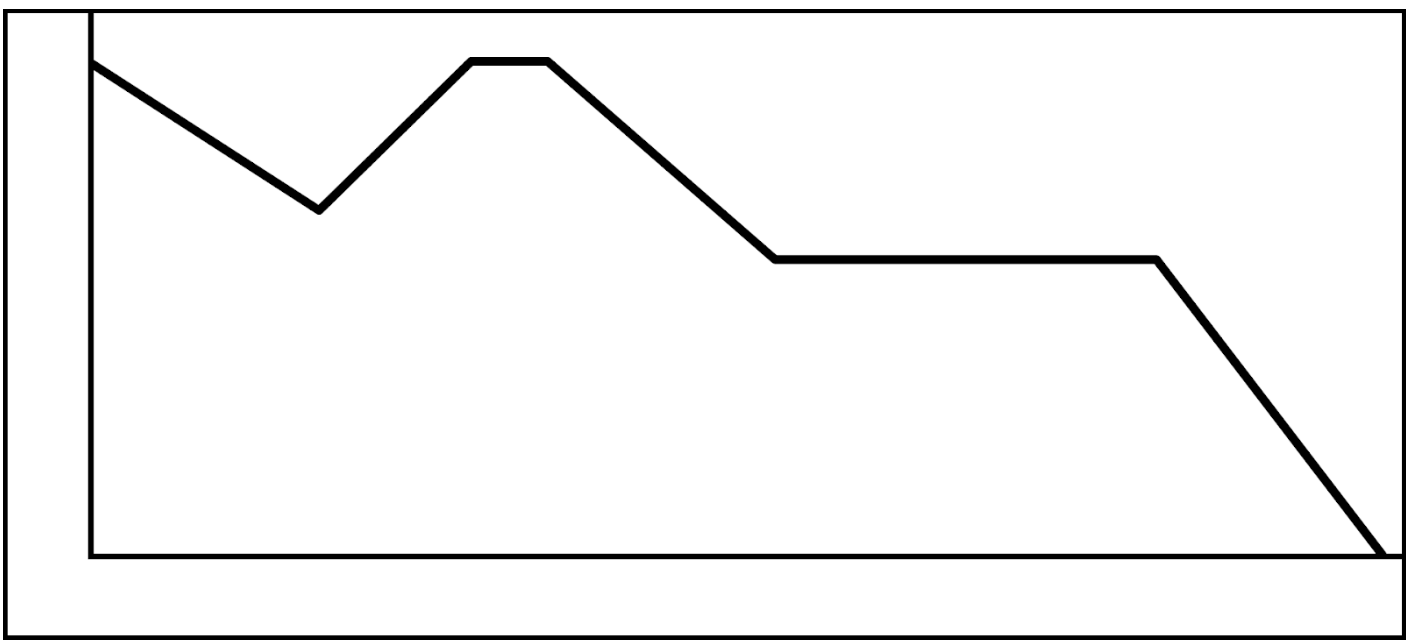
Unit 8.5, Lesson 6: Notes Name ________________________________

Creating Graphs of Functions

Learning Goal(s):

Elena starts to walk home from school. She turns around and goes back to school because she left something in her locker. At school, she runs into a friend who invites her to the library to do homework. She goes to the library, reads a book, then heads home to do her chores.

Label both axes so that the graph accurately represents the situation.	Label each segment with what is happening in the story during that time. (E.g., in the first segment, she is **walking home from school**).



Summary Question

What is important to pay attention to when drawing the graph of a function from a story?

desmos

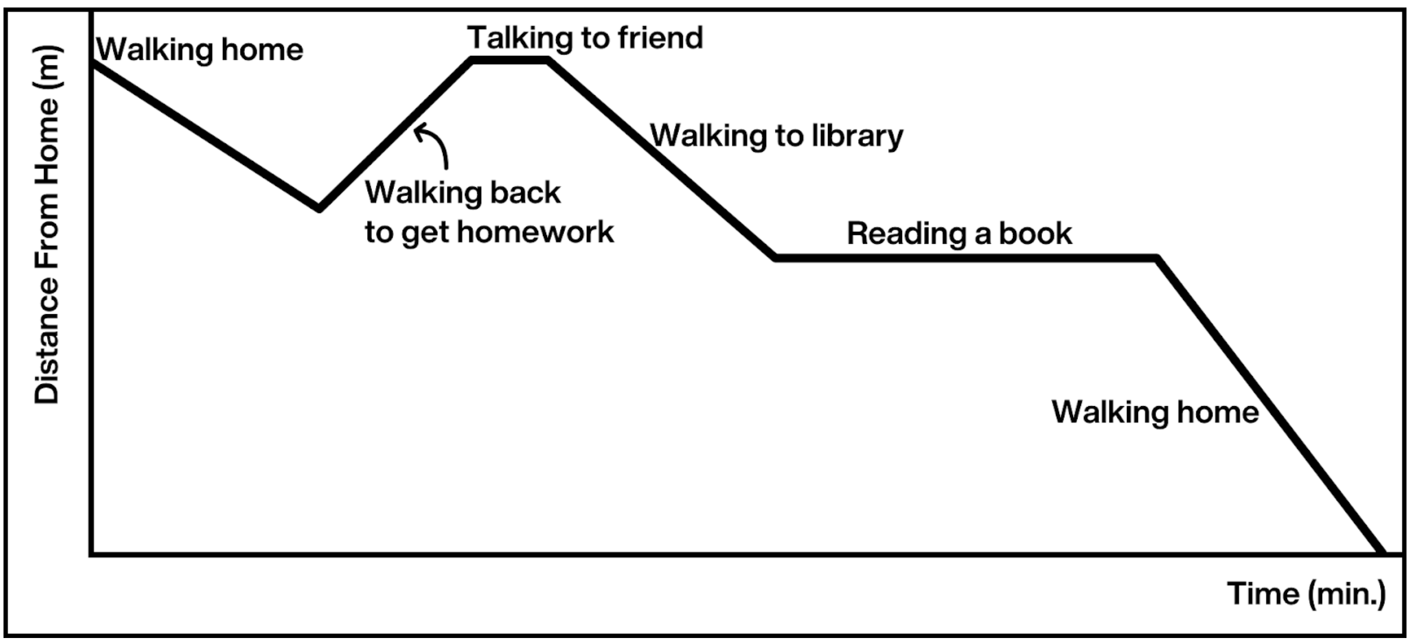
Unit 8.5, Lesson 6: Notes Name ___________________________

Creating Graphs of Functions

Learning Goal(s): ● **I can draw the graph of a function that represents a real-world situation.** ● **I can explain that graphs can appear different depending on the variables chosen.**

Elena starts to walk home from school. She turns around and goes back to school because she left something in her locker. At school, she runs into a friend who invites her to the library to do homework. She goes to the library, reads a book, then heads home to do her chores.

Label both axes so that the graph accurately represents the situation.	Label each segment with what is happening in the story during that time. (E.g., in the first segment, she is **walking home from school**).



Summary Question

What is important to pay attention to when drawing the graph of a function from a story?

Make sure to pay attention to the quantity being measured. For example, when creating a graph between “height” and time, ask yourself “the height of what?” Also, pay attention to the units! If you measure in feet, but the graph asks for meters, your graph will have the right shape, but will be the wrong size. It’ll be squished.

desmos Science Mom Lesson 78

Unit 8.5, Lesson 7: Notes Name ____________________

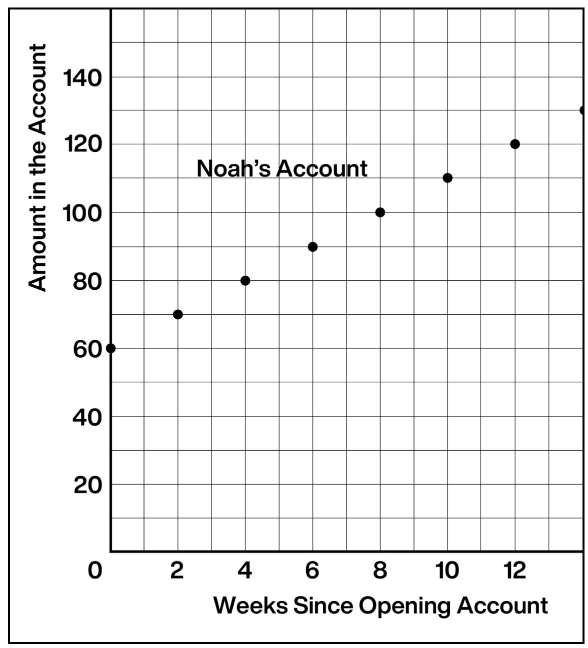
Comparing Representations of Functions

Learning Goal(s):

Elena opened an account on the same day as Noah. The amount of money, E, in Elena's account is given by the function $E = 8w + 70$, where w is the number of weeks since the account was opened. The graph below shows some data about the amount of money in Noah's account.

Who started out with more money in their account? Explain how you know.

Who is saving money at a faster rate? Explain how you know.



Write one question that might be easier to answer using the equation than using the graph.	Write one question that might be easier to answer using the graph than using the equation.

Summary Question: What are the strengths of using . . .

. . . a table? . . . a graph? . . . an equation?

Unit 8.5, Lesson 7: Notes Name ______________________________

Comparing Representations of Functions

Learning Goal(s):

- **I can explain the strengths and weaknesses of different representations.**
- **I can compare inputs and outputs of functions that are represented in different ways.**

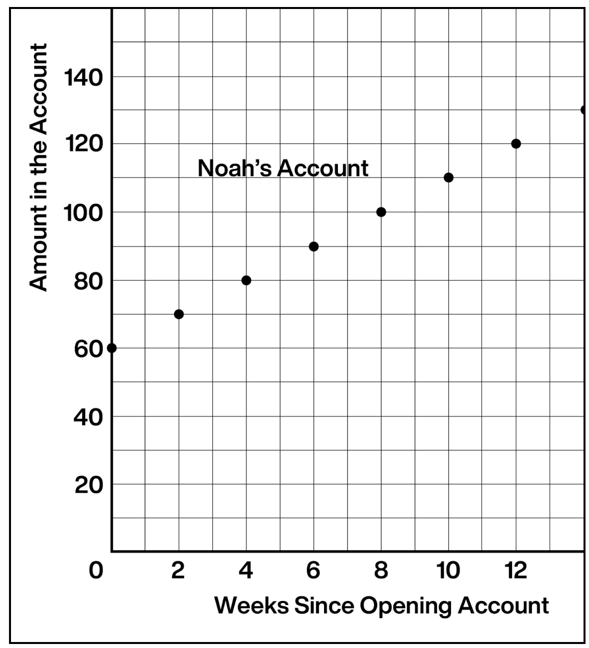
Elena opened an account on the same day as Noah. The amount of money, E, in Elena's account is given by the function $E = 8w + 70$, where w is the number of weeks since the account was opened. The graph below shows some data about the amount of money in Noah's account.

Who started out with more money in their account? Explain how you know.

Elena starts out with more money. When $w = 0$, Elena has $\$70$, while Noah has $\$60$.

Who is saving money at a faster rate? Explain how you know.

Elena is saving money at a faster rate. She adds $\$8$ to her account each week. Noah adds $\$10$ every 2 weeks, or $\$5$ per week.



Write one question that might be easier to answer using the equation than using the graph.

If the trend continues this way, how much money will be in the account after 20 weeks?

Write one question that might be easier to answer using the graph than using the equation.

Is the amount of money in the account increasing or decreasing over time?

Summary Question: What are the strengths of using . . .

. . . a table? . . . a graph? . . . an equation?

One strength of a table is that it is easy to pick out specific input-output pairs. Graphs make it easier to see the big picture, like trends and comparative rates of change. Equations are useful for finding *any* input-output pair.

desmos **Science Mom Lesson 79**

Unit 8.5, Lesson 9: Notes Name ____________________________

Modeling With Piecewise Linear Functions

Learning Goal(s):

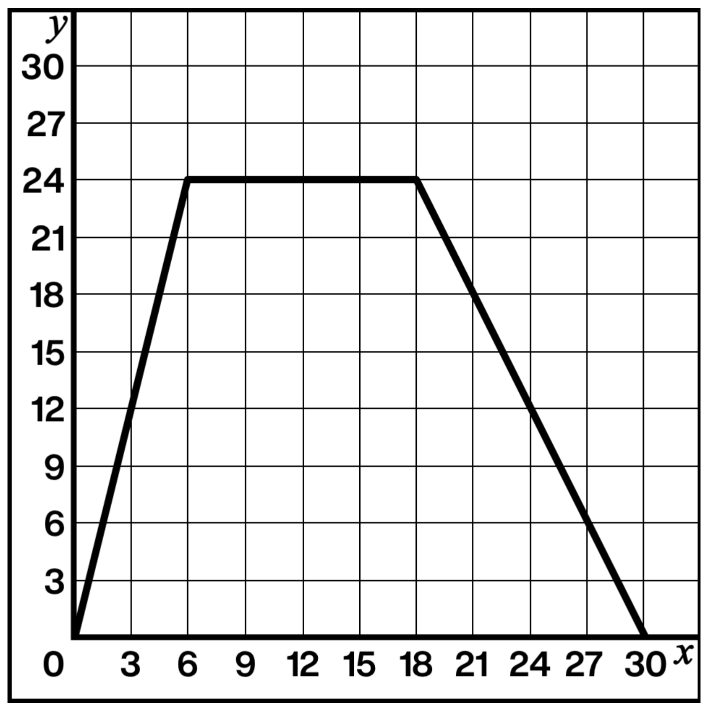
Deiondre gave their dog a bath in a bathtub. This graph shows the volume of water in the tub, in gallons, as a function of time, in minutes.

Why do you think this function is called a piecewise linear function?

At what rate did the water in the tub fill up? Explain how you know.

At what rate did the water in the tub drain? Explain how you know.

Select one linear piece of this function. Then write an equation for that piece in the form $y = mx + b$.



x **represents the time (min.).**

y **represents the water in the bath (gal.).**

Summary Question

How would you describe a piecewise linear function to someone who has never seen one?

desmos

Unit 8.5, Lesson 9: Notes Name ___________________________

Modeling With Piecewise Linear Functions

Learning Goal(s):

- **I can create graphs of nonlinear functions with pieces of linear functions.**
- **I can calculate and interpret rates of change in context.**

Deiondre gave their dog a bath in a bathtub. This graph shows the volume of water in the tub, in gallons, as a function of time, in minutes.

Why do you think this function is called a piecewise linear function?

This function is made up of three different pieces of linear functions.

At what rate did the water in the tub fill up? Explain how you know.

The water in the tub filled up at a rate of 4 gallons every minute. In the first 3 minutes, the amount of water went from 0 gallons to 12 gallons. $\frac{12}{3} = 4.$

At what rate did the water in the tub drain? Explain how you know.

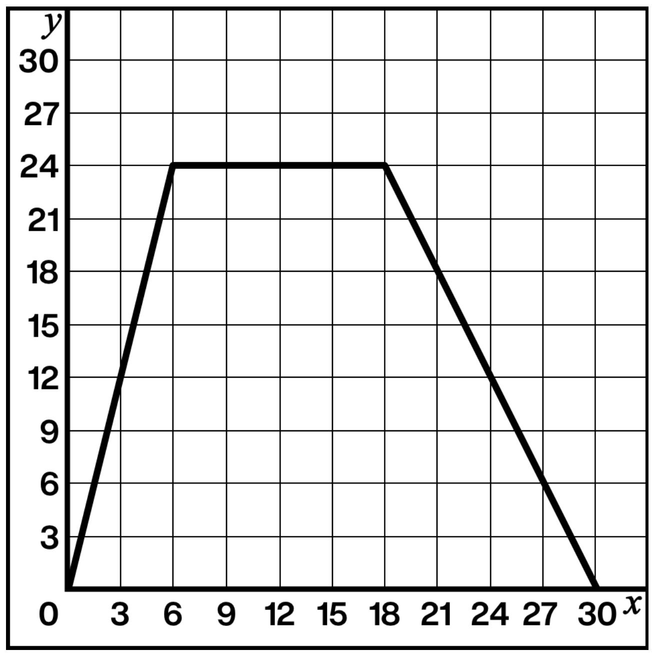
The tub drained at a rate of 2 gallons every minute. In the last 3 minutes, the amount of water went from 6 gallons to 0 gallons. $\frac{6}{3} = 2.$

Write an equation in the form $y = mx + b$ for any linear segment of this function.

1st: $y = 4x$

2nd: $y = 24$

3rd: $y = -2x + 60$



x **represents the time (min.).**

y **represents the water in the bath (gal.).**

Summary Question

How would you describe a piecewise linear function to someone who has never seen one?

A piecewise linear function is made up of some number of linear segments connected to make a continuous function.

desmos Science Mom Lesson 80

Unit 8.6, Lesson 1: Notes Name ____________________

Organizing Data

Learning Goal(s):

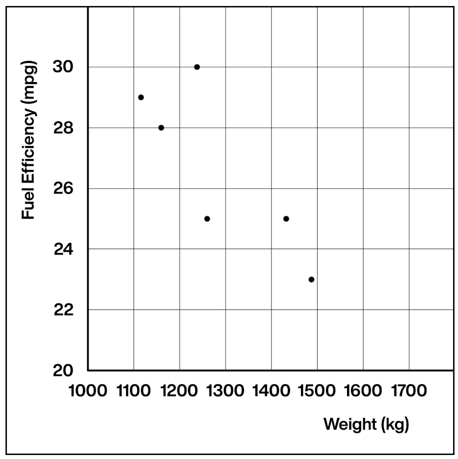
We can organize and display data with two variables in different ways.

Latifa is curious about different cars and their fuel efficiency (miles driven for each gallon of gas).

Table

Car Weight (kg)	**Fuel Efficiency (mpg)**
1116	28.93
1160	27.88
1238	29.94
1260	24.95
1432	25
1487	22.96

Scatter Plot



Predict the fuel efficiency of a typical car that weighs 1600 kilograms.

A teacher asked her students how many hours of sleep they had the night before a test.

How might you organize or display this data?

Why might someone want to organize it this way?

Student	**Hours of Sleep**	**Score**
Ayaan	7	74
Emika	6	76
Inola	8	88
Kwasi	5	63
Zoe	7	90

Summary Questions

What is one advantage of representing data in . . .

. . . a scatter plot?

. . . a table?

Unit 8.6, Lesson 1: Notes Name ____________________________

Organizing Data

Learning Goal(s):
- **I can organize data to notice patterns more clearly.**
- **I can describe the advantages and disadvantages of organizing data in different ways.**

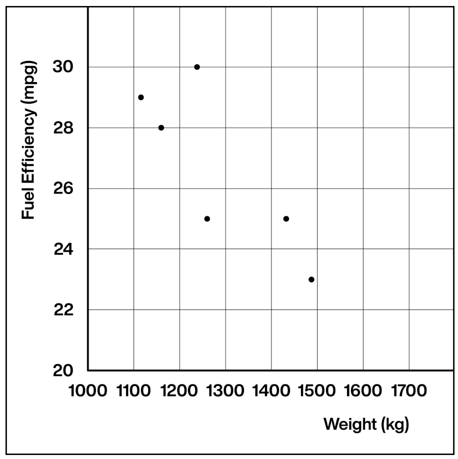
We can organize and display data with two variables in different ways.

Latifa is curious about different cars and their fuel efficiency (miles driven for each gallon of gas).

Table

Car Weight (kg)	Fuel Efficiency (mpg)
1116	28.93
1160	27.88
1238	29.94
1260	24.95
1432	25
1487	22.96

Scatter Plot



Predict the fuel efficiency of a typical car that weighs 1600 kilograms.

Approximately 21 **miles per gallon.**

A teacher asked her students how many hours of sleep they had the night before a test.

How might you organize or display this data?
Responses vary.
- **Sort the table by hours of sleep or score.**
- **Create a scatter plot.**

Why might someone want to organize it this way?
Responses vary.
- **In a sorted table, it is easier to see patterns.**
- **In a scatter plot, it is easier to see the relationship between both variables.**

Student	Hours of Sleep	Score
Ayaan	7	74
Emika	6	76
Inola	8	88
Kwasi	5	63
Zoe	7	90

Summary Question

What is one advantage of representing data in . . .

. . . a scatter plot? ***Responses vary.***

It is easier to see trends in the data.

. . . a table? ***Responses vary.***

It is easier to see values of individual data points.

desmos **Science Mom Lesson 81**

Unit 8.6, Lesson 2: Notes Name ___________________

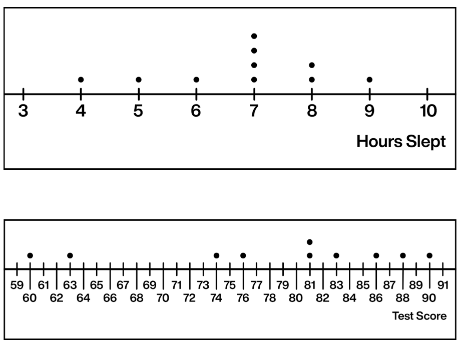
Plotting Data

Learning Goal(s):

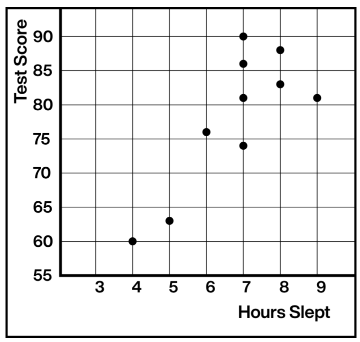
Representing data with a scatter plot is different from ways we have represented data before.

A teacher asked her students how many hours of sleep they had the night before a test.

Dot Plots



Scatter Plot

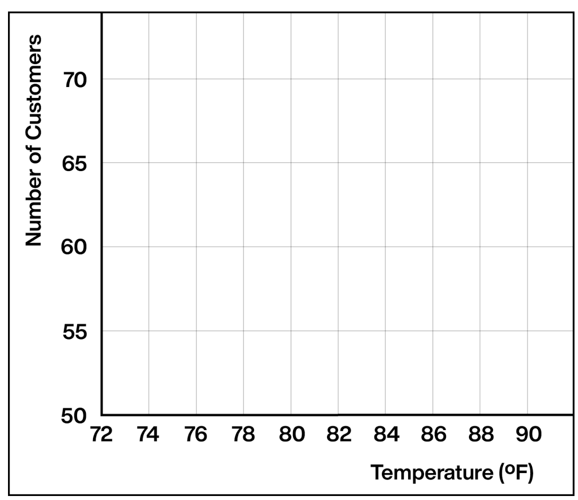


What is different about the two ways of representing the data?

One week, an ice cream stand collected data on the temperature and the number of customers.

Create a scatter plot of this data.

Day	Temperature (ºF)	Number of Customers
Monday	85	58
Tuesday	83	55
Wednesday	90	63
Thursday	75	50
Friday	85	72



Summary Question

Scatterplots allow us to investigate possible connections between two numerical variables.

Explain what this sentence means in your own words.

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Unit 8.6, Lesson 2: Notes Name ______________________________

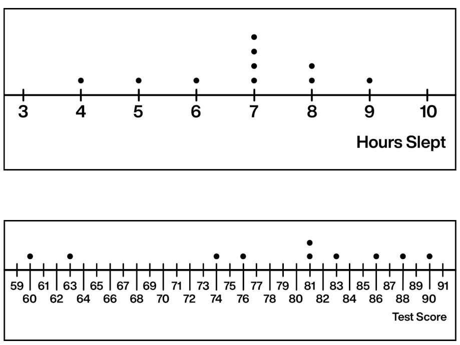
Plotting Data

Learning Goal(s):
- **I can compare and contrast two different ways to display data (a dot plot and a scatter plot).**
- **I can draw a scatter plot to represent data.**

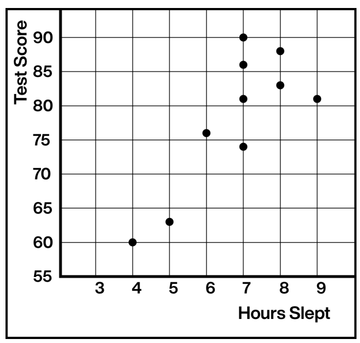
Representing data with a scatter plot is different from ways we have represented data before.

A teacher asked her students how many hours of sleep they had the night before a test.

Dot Plots



Scatter Plot



What is different about the two ways of representing the data?

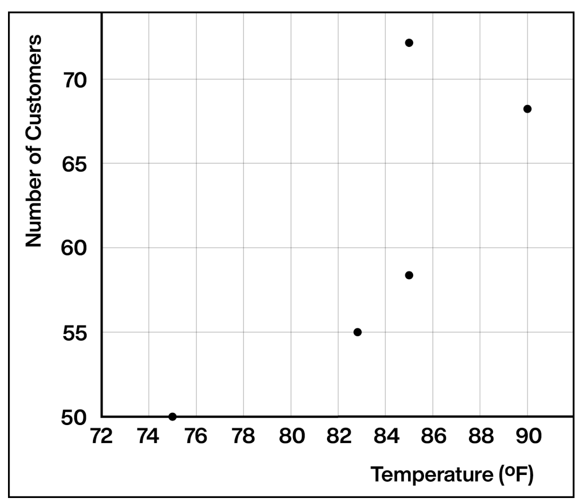
Responses vary.

Dot plots separate each variable and scatter plots show both variables at once.

One week, an ice cream stand collected data on the temperature and the number of customers.

Create a scatter plot of this data.

Day	Temperature (ºF)	Number of Customers
Monday	85	58
Tuesday	83	55
Wednesday	90	63
Thursday	75	50
Friday	85	72



Summary Question

Scatter plots allow us to investigate possible connections between two numerical variables. Explain what this sentence means in your own words.

Responses vary. **This sentence means that scatter plots help us see possible relationships between two variables that involve counting or numbers.**

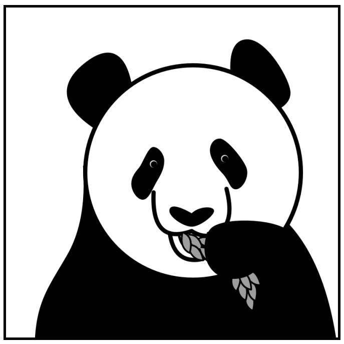
Unit 8.6, Lesson 3: Notes Name ___________________________________

What a Point in a Scatter Plot Means

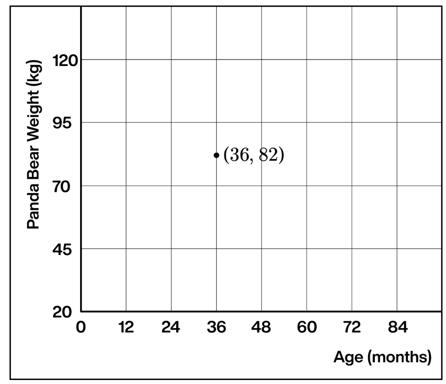
Learning Goal(s):

Scatter plots are made up of many individual data points. What do each of those points represent?

A giant panda lives in a zoo. What does the point on the graph tell you about the panda?



The panda is ______ months old and weighs ______ kilograms.

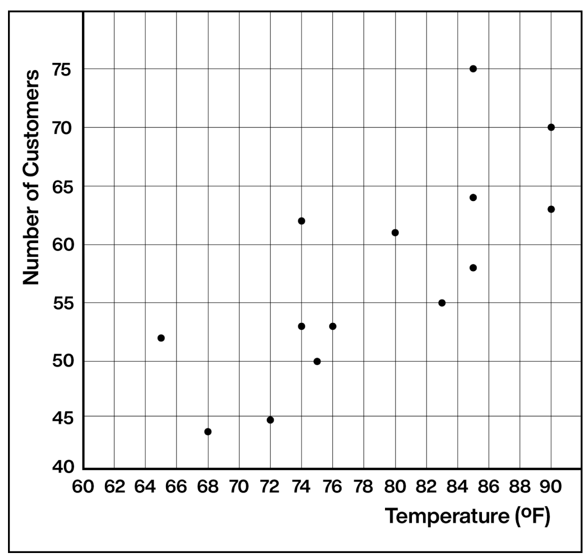


An ice cream stand collected data on the temperature and the number of customers over time.

Put a circle around the data point that represents the day it was $72\,°$F outside.

Put a square around the day when the stand had the most number of customers.

Why might the ice cream stand want to collect and visualize this data?



Summary Question

Describe a strategy to determine what a single point on a scatter plot means.

desmos

Unit 8.6, Lesson 3: Notes Name ______________________________

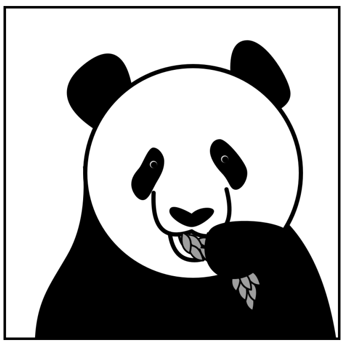
What a Point in a Scatter Plot Means

Learning Goal(s):

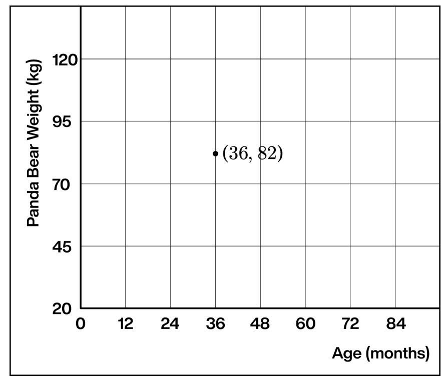
- **I can describe the meaning of a point on a scatter plot in context.**

Scatter plots are made up of many individual data points. What do each of those points represent?

A giant panda lives in a zoo. What does the point on the graph tell you about the panda?



The panda is 36 months old and weighs 82 kilograms.



An ice cream stand collected data on the temperature and the number of customers over time.

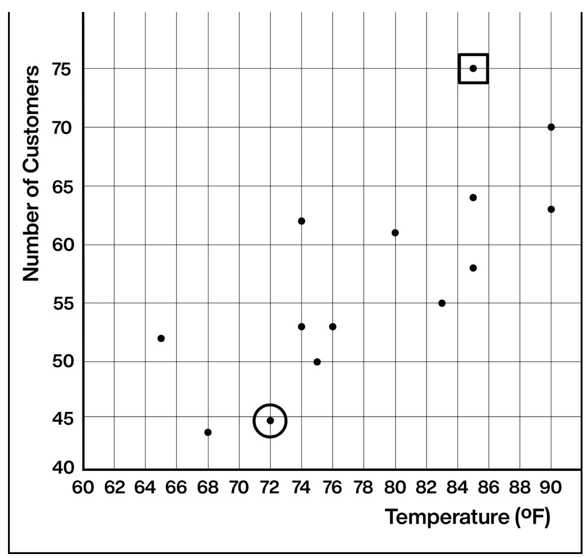
Put a circle around the data point that represents the day it was 72° F outside.

Put a square around the day when the stand had the most number of customers.

Why might the ice cream stand want to collect and visualize this data?

Responses vary.

The ice cream stand might be curious if there is an association between the weather and how many customers they have so they can plan how much ice cream to make that day.



Summary Question

Describe a strategy to determine what a single point on a scatter plot means.

One strategy to determine what a point means is to look at the x-value and the label on the x-axis to figure out what one variable represents. Do the same with the y-value and y-axis to determine the other variable.

desmos Science Mom Lesson 83

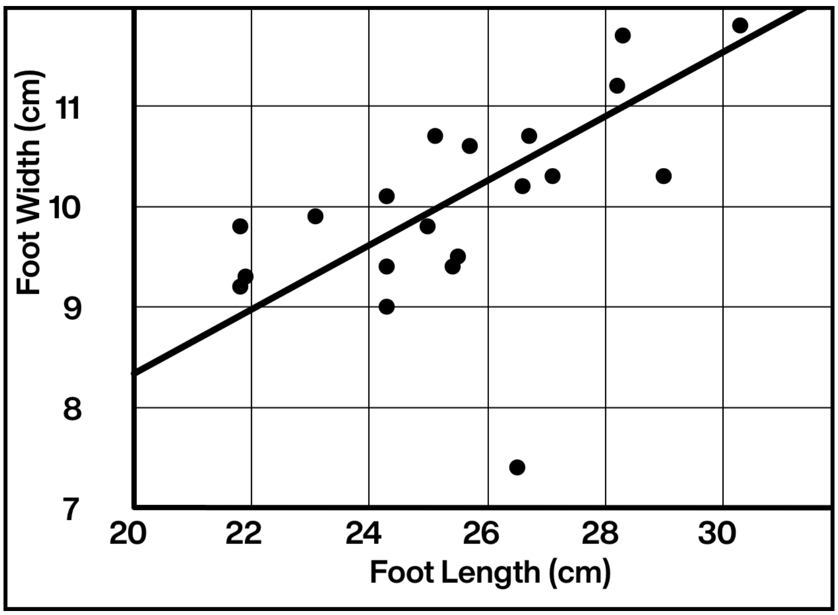
Unit 8.6, Lesson 4: Notes Name ___________________________________

Lines of Fit and Outliers

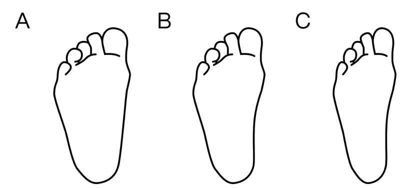
Learning Goal(s):

What if we want to make predictions about data not in the original data set? We can use linear functions to model data on a scatter plot. Models typically fit some data points well and not others.

This is data collected about different feet's length and width.



These three feet are all size 8 (about 24 centimeters long).



Label each foot on the scatter plot.

Which foot does the linear model fit best? ______ Explain your thinking.

Circle the outlier on this graph. On the right, draw what the outlier foot might look like.

Is the outlier wider or less wide than predicted for its length?

Summary Question

What does it mean for a data point to be an outlier?

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Unit 8.6, Lesson 4: Notes Name ____________________

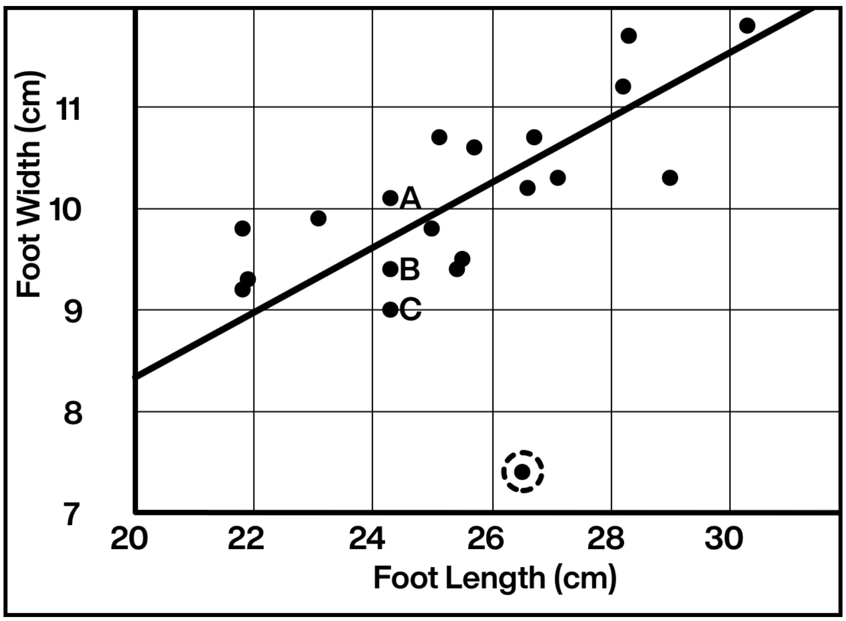
Lines of Fit and Outliers

Learning Goal(s):

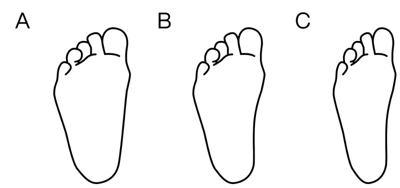
- **I can use a line of fit to predict values not in the data.**
- **I can identify outliers on a scatter plot.**

What if we want to make predictions about data not in the original data set? We can use linear functions to model data on a scatter plot. Models typically fit some data points well and not others.

This is data collected about different feet's length and width.



These three feet are all size 8 (about 24 centimeters long).



Label each foot on the scatter plot.

Response on the graph.

Which foot does the linear model fit best? **B** Explain your thinking.

***Responses vary.* Foot B is closest to the fitted line.**

Circle the outlier on this graph. On the right, draw what the outlier foot might look like. ***Response on the graph.***

Is the outlier wider or less wide than predicted for its length?
***Responses vary.* The outlier foot will be much less wide than predicted.**

Responses vary.

Summary Question

What does it mean for a data point to be an outlier?

***Responses vary*. A data point is an outlier if it is far away from the other points.**

desmos Science Mom Lesson 84

Unit 8.6, Lesson 5: Notes Name ___________________________

Fitting a Line to Data

Learning Goal(s):

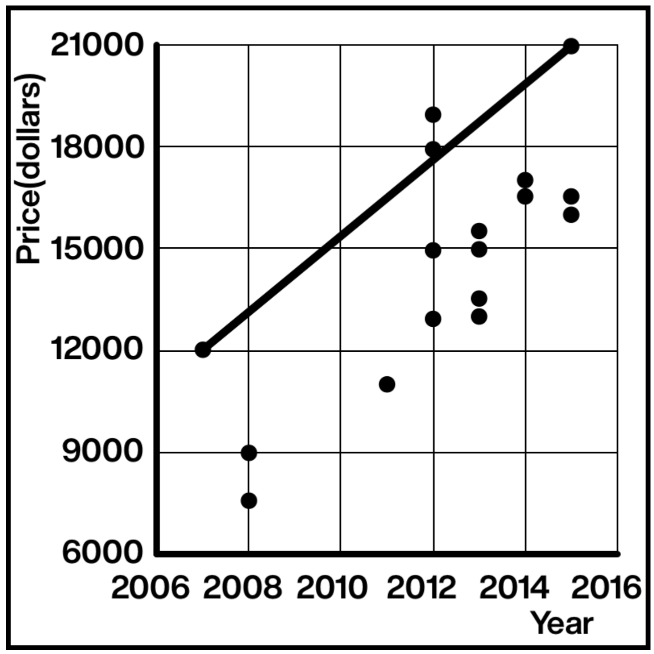
For any given data set with a linear association, there are infinite linear models we can draw. How do we decide what linear models are good fits for the data?

Here is data about the price of a used car and the year it was manufactured.

Saanvi drew this line of fit for the data.

Why might she have chosen this line?

Explain why this model is not a good fit for the data.



Draw a linear model that fits the data better. Explain how you chose your model.

Summary Question

Describe some characteristics of a line that is a good fit for the data in a scatter plot.

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Unit 8.6, Lesson 5: Notes Name ___________________________

Fitting a Line to Data

Learning Goal(s):

- **I can draw a line to fit data in a scatter plot.**
- **I can describe features of a line that fits data well.**

For any given data set with a linear association, there are infinite linear models we can draw. How do we decide what linear models are good fits for the data?

Here is data about the price of a used car and the year it was manufactured.

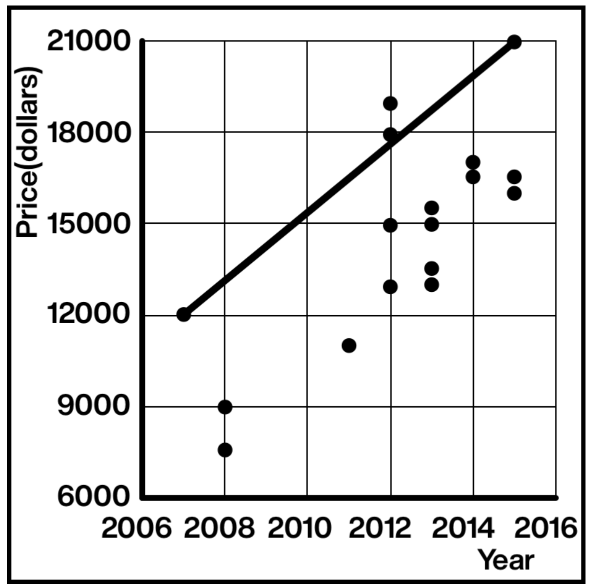
Saanvi drew this line of fit for the data.

Why might she have chosen this line?

***Responses vary.* This line goes through the leftmost point on the scatter plot and one of the rightmost points on the scatter plot.**

Explain why this model is not a good fit for the data.

***Responses vary.* This model is not a good fit because more of the data is below the line than above the line. This means that the line would overpredict most of the data.**



Responses vary.

Draw a linear model that fits the data better. Explain how you chose your model.

***Responses vary.* This model is a better fit because the line has a positive trend, and about half of the data points are below the line of fit and half of the points are above the line of fit.**

Summary Question

Describe some characteristics of a line that is a good fit for the data in a scatter plot.

Responses vary.

- **The direction (or slope) of the line matches the trend of the data.**
- **The line passes through the "middle" of the data.**
- **The points are as close as possible to the line.**

desmos Science Mom Lesson 85

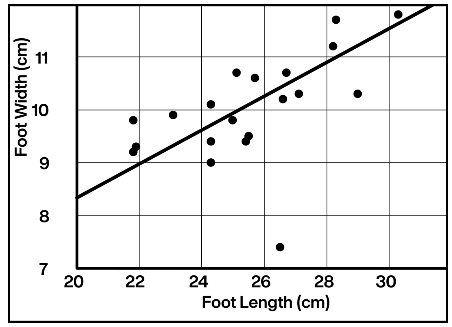
Unit 8.6, Lesson 6: Notes Name ___________________________________

The Slope of a Fitted Line

Learning Goal(s):

Sometimes we want to know how two variables are related. In this case, we can use the slope of a linear model to explain how increasing one variable typically changes the other.

Here is a scatter plot of foot length and width for various feet.

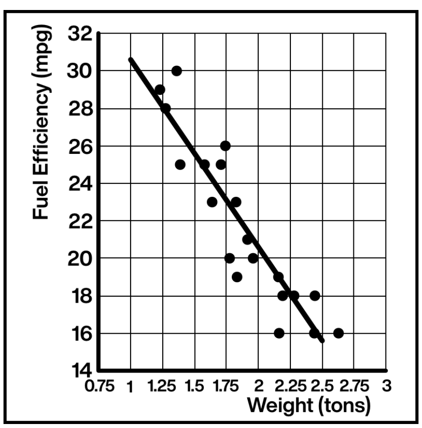


As foot length increases, foot width tends to ________________.

This means there is a positive association/a negative association/ no association between foot length and foot width.

The slope of the fitted line is about 0.32. If the length of a foot increases by ____________, the model predicts that its width will increase/decrease by _____________.

Here is data on the weight of 21 cars and their fuel efficiency (miles driven for each gallon of gas).



Describe the relationship between weight and fuel efficiency.

The slope of the fitted line is about -10. What does this number mean for the weight of a car and its predicted fuel efficiency?

Summary Question

When looking at a scatter plot of data, how can we tell if there is . . .

. . . a positive association? . . . a negative association? . . . no association?

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Unit 8.6, Lesson 6: Notes Name ___________________________

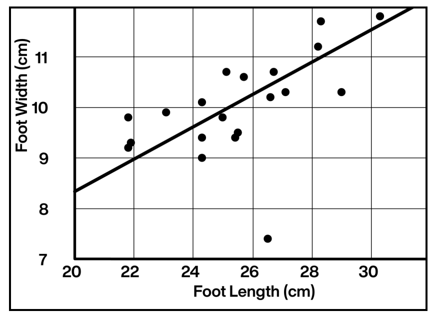
The Slope of a Fitted Line

Learning Goal(s):

- **I can explain whether data in a scatter plot has a positive association, a negative association, or neither.**
- **I can interpret the slope of a line fit to data in a real-world situation.**

Sometimes we want to know how two variables are related. In this case, we can use the slope of a linear model to explain how increasing one variable typically changes the other.

Here is a scatter plot of foot length and width for various feet.

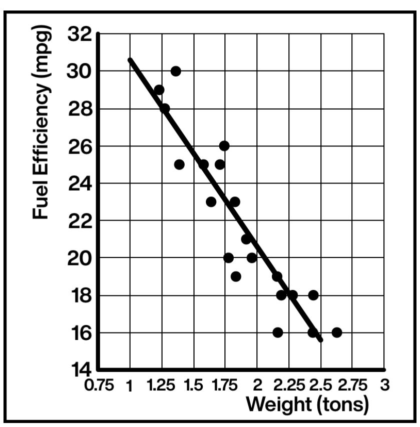


As foot length increases, foot width tends to **increase**.

This means there is a **positive association**/negative association/ no association between foot length and foot width.

The slope of the fitted line is about 0.32. If the length of a foot increases by 1 **cm**, the model predicts that its width will **increase**/decrease by 0.32 **cm**.

Here is data on the weight of 21 cars and their fuel efficiency (miles driven for each gallon of gas).



Describe the relationship between weight and fuel efficiency.

Responses vary. **There is a negative association between weight and fuel efficiency. As the weight of the car increases, the fuel efficiency decreases.**

The slope of the fitted line is about -10. What does this number mean for the weight of a car and its predicted fuel efficiency?

If the weight of a car increases by 1 ton, the model predicts that its fuel efficiency will decrease by 10 mi./ gal.

Summary Question

When looking at a scatter plot of data, how can we tell if there is . . .

. . . a positive association?
As one variable increases, the other variable tends to increase.

. . . a negative association?
As one variable increases, the other variable tends to decrease.

. . . no association?
There is no clear pattern or trend.

desmos Science Mom Lesson 86

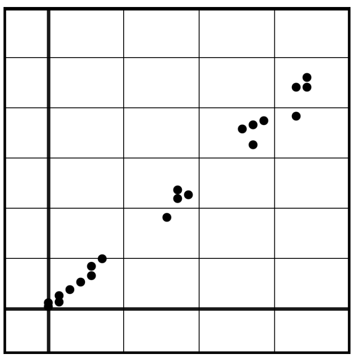
Unit 8.6, Lesson 7: Notes Name ___________________________________

Observing More Patterns in Scatter Plots

Learning Goal(s):

Sometimes the points in a scatter plot show an association, and sometimes there is no association.

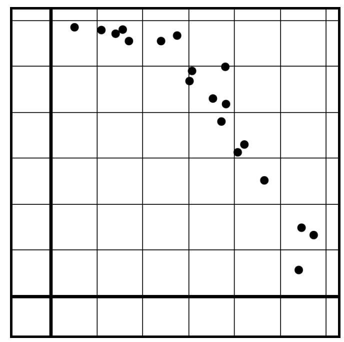
Circle the terms that describe the association in each scatter plot.



Positive / negative / no association

Linear / non-linear association

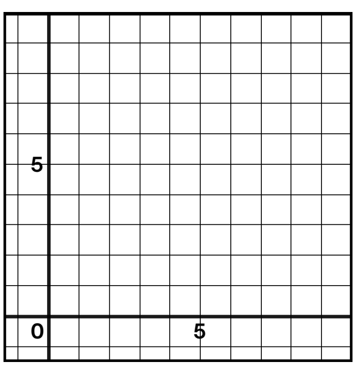
With / without clustering



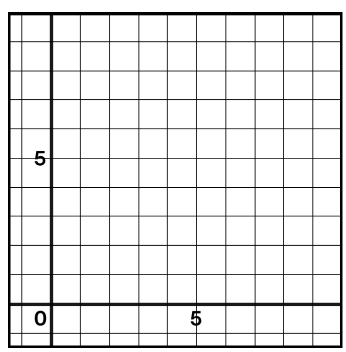
Positive / negative / no association

Linear / non-linear association

With / without clustering



Draw a scatter plot that shows no association.



Draw a scatter plot that shows a negative linear association with clustering.

Summary Question

What is a strategy you can use to decide if two variables have a linear association?

desmos

Unit 8.6, Lesson 7: Notes Name ________________________________

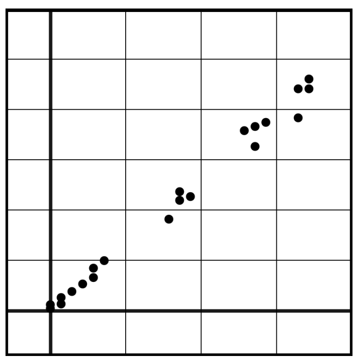
Observing More Patterns in Scatter Plots

Learning Goal(s):

- **I can use a scatter plot to decide if two variables have a linear association and make connections to what the data represents.**
- **I can pick out clusters in data and make connections to what the data represents.**

Sometimes the points in a scatter plot show an association, and sometimes there is no association.

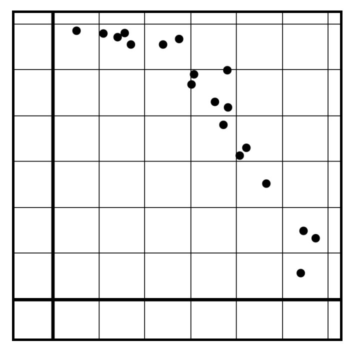
Circle the terms that describe the association in each scatter plot.



Positive / negative / no association

Linear / non-linear association

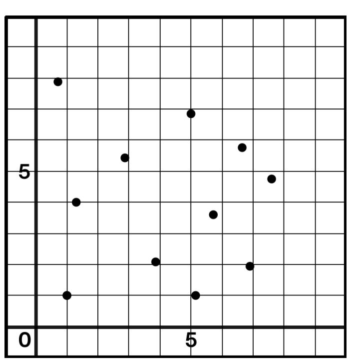
With / without clustering



Positive / **negative** / no association

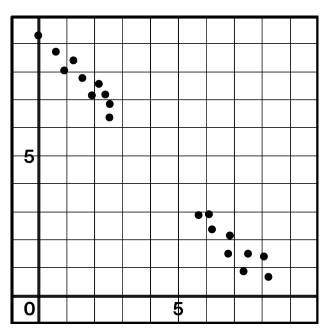
Linear / **non-linear** association

With / **without** clustering



Draw a scatter plot that shows no association.

Responses vary.



Draw a scatter plot that shows a negative linear association with clustering.

Responses vary.

Summary Question

What is a strategy you can use to decide if two variables have a linear association?

Responses vary. **Draw a line through the middle of the points with a slope that has the same sign as the association. If the points follow the pattern of the line, it is a linear association.**

desmos Science Mom Lesson 87

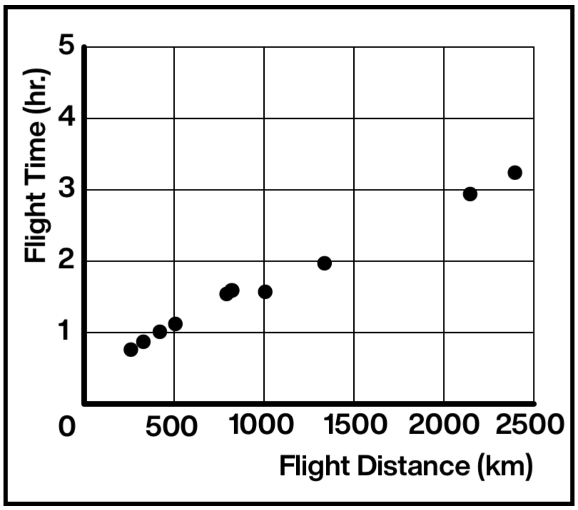
Unit 8.6, Lesson 8: Notes Name ________________________________

Analyzing Bivariate Data

Learning Goal(s):

People often collect data to investigate possible associations between two numerical variables and use the connections that they find to predict more values of the variables.

The scatter plot shows flight distances and times for a set of flights.



Sketch a line on the scatter plot that fits the data well.

Add a point to the scatter plot that shows a $1,500$-kilometer flight with a flight time of 2 hours.

Add an outlier to the scatter plot.

Explain why this point is an outlier.

Describe the association between flight distance and flight time.

Use your model to predict the y-value of a point on the scatter plot with $x = 2000$. ________

What does this point tell you about the flight distance and flight time for the airplane?

Summary Question
What are some things that are important to remember when analyzing a scatter plot?

desmos

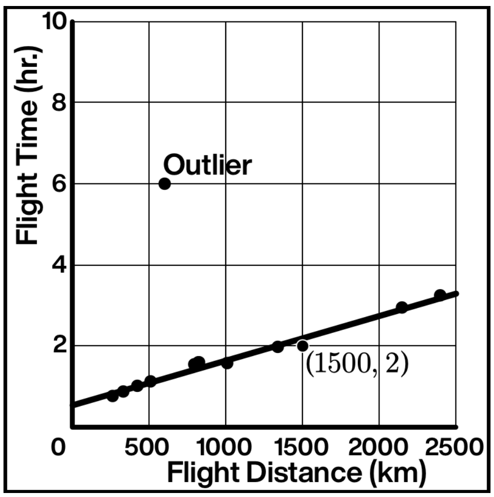
Unit 8.6, Lesson 8: Notes Name ___________________________

Analyzing Bivariate Data

Learning Goal(s):
- **I can create a scatter plot and draw a line to fit the data, and identify outliers that appear in the data.**
- **I can use associations between two variables to make predictions.**

People often collect data to investigate possible associations between two numerical variables and use the connections that they find to predict more values of the variables.

The scatter plot shows flight distances and times for a set of flights.



Sketch a line on the scatter plot that fits the data well.

Add a point to the scatter plot that shows a $1,500$-kilometer flight with a flight time of 2 hours.

Add an outlier to the scatter plot.

Explain why this point is an outlier.

***Responses vary.* This point is an outlier because it is very far from the rest of the data, and it is not close to the line. This flight took much longer than the typical flight of its distance.**

Describe the association between flight distance and flight time.

***Responses vary.* As flight distance increases, the flight time tends to increase.**

Use your model to predict the y-value of a point on the scatter plot with $x = 2000$. $y = 2.75$

What does this point tell you about the flight distance and flight time for the airplane?

***Responses vary.* A flight that is $2,000$ kilometers will take around 2.75 hours.**

Summary Question

What are some things that are important to remember when analyzing a scatter plot?

Responses vary.
- **When analyzing a scatter plot, look for trends in the data to decide if there is an association between the two variables.**
- **If an association is linear, then there is a line that can be drawn to fit the data.**
- **Points that are far from the line and from the rest of the data are called outliers.**

desmos Science Mom Lesson 88

Unit 8.6, Lesson 9: Notes Name ______________________________

Two-Way Tables and Bar Graphs

Learning Goal(s):

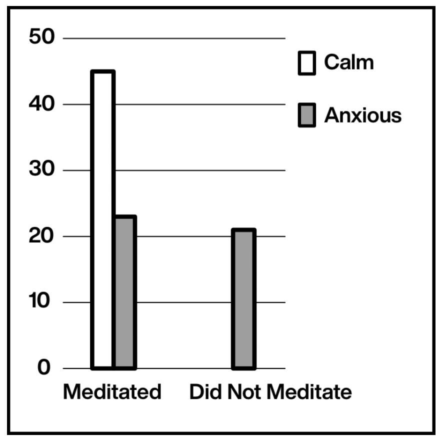
When we collect data by measuring attributes, such as height, we call that numerical data. When we collect data by counting things in various categories, such as tall or short, we call that categorical data. To help organize categorical data, we can use two-way tables and bar graphs.

These are the results of a study on meditation and athletes' state of mind before a track meet.

Two-Way Table

	Meditated	Did Not Meditate	Total
Calm	45		53
Anxious	23	21	
Total		29	97

Bar Graph



Fill in the missing values in the table.

Add a bar above to represent the number of people who did not meditate and were calm.

Add a star where 21 appears in the bar graph. What does 21 mean in this scenario?

Circle 44 in the two-way table. What does 44 mean in this scenario?

Summary Question

What are some advantages to displaying information in . . .

. . . a two-way table?

. . . a bar graph?

Unit 8.6, Lesson 9: Notes Name ____________________

Two-Way Tables and Bar Graphs

Learning Goal(s):

- **I can identify and represent the same data in bar graphs and in two-way frequency tables.**

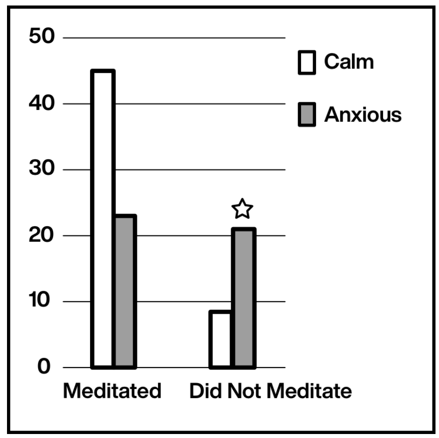
When we collect data by measuring attributes, such as height, we call that numerical data. When we collect data by counting things in various categories, such as tall or short, we call that categorical data. To help organize categorical data, we can use two-way tables and bar graphs.

These are the results of a study on meditation and athletes' state of mind before a track meet.

Two-Way Table

	Meditated	Did Not Meditate	Total
Calm	45	8	53
Anxious	23	21	44
Total	68	29	97

Bar Graph



Fill in the missing values in the table.

Add a bar above to represent the number of people who did not meditate and were calm.

Add a star where 21 appears in the bar graph. What does 21 mean in this scenario?

Responses vary. **There were 21 athletes in the study who were anxious and did not meditate.**

Circle 44 in the two-way table. What does 44 mean in this scenario?

Responses vary. **In total, there were 44 athletes in the study who were anxious.**

Summary Question

What are some advantages to displaying information in . . .

. . . a two-way table?

Responses vary. **You can see the precise numbers in each category.**

. . . a bar graph?

Responses vary. **You can compare data in different categories by looking at the heights of the bars.**

Unit 8.6, Lesson 10: Notes Name ______________________

Using Data Displays to Find Associations

Learning Goal(s):

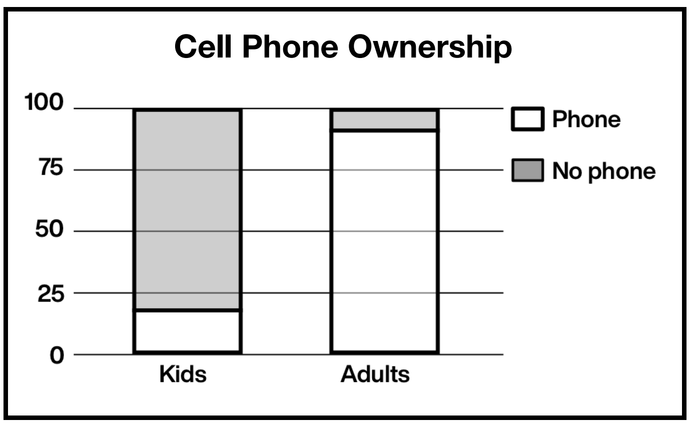
Flu Treatment Results

	Treatment A	Treatment B
Improved Health	57.5%	41.7%
No Improvement	42.5%	58.3%
Total	100%	100%

_______ of people who took Treatment A had improved health, whereas ______ of those who took Treatment B had improved health.

This means there **is / is not** an association between treatment and improved health.

For each situation, decide if there is an association. Explain your thinking.



(Circle one) There **is / is not** an association between age and cell phone ownership.

Explain your thinking:

Lucky Socks and Winning

	Winners	Losers	Total
Lucky Socks	80%	20%	100%
Regular Socks	79%	21%	100%

(Circle one) There **is / is not** an association between wearing lucky socks and winning.

Explain your thinking:

Summary Question

How can you tell when there is a possible association between variables?

Unit 8.6, Lesson 10: Notes Name ____________________

Using Data Displays to Find Associations

Learning Goal(s):
- **I can use relative frequencies in tables and in segmented bar graphs to decide if there is an association between two variables.**

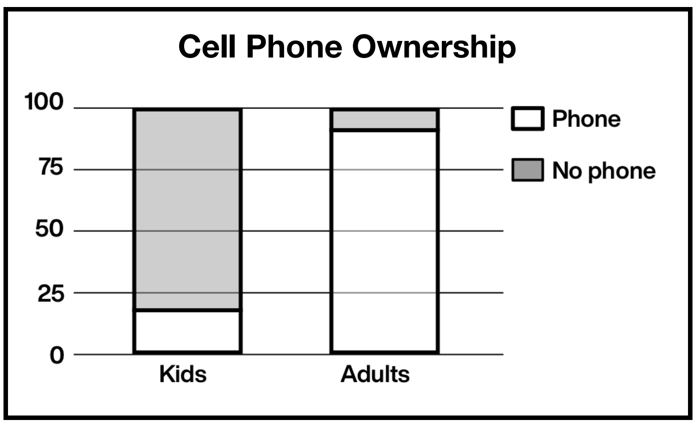
Flu Treatment Results

	Treatment A	Treatment B
Improved Health	57.5%	41.7%
No Improvement	42.5%	58.3%
Total	100%	100%

57.5% of people who took Treatment A had improved health, whereas 41.7% of those who took Treatment B had improved health.

This means there **is** / is not an association between treatment and improved health.

For each situation, decide if there is an association. Explain your thinking.



(Circle one) There **is** / is not an association between age and cell phone ownership.

Explain your thinking: ***Responses vary.***
The percentage of adults who use a cell phone (about 90%) is much larger than the percentage of kids who use one (about 20%).

Lucky Socks and Winning

	Winners	Losers	Total
Lucky Socks	80%	20%	100%
Regular Socks	79%	21%	100%

(Circle one) There is / **is not** an association between wearing lucky socks and winning.

Explain your thinking: ***Responses vary.***
The percentage of winners wearing lucky socks is only 1% greater than those wearing regular socks, so there is not an association.

Summary Question
How can you tell when there is a possible association between variables?

Responses vary. **There is a possible association when there is big difference between how the total (100%) is split between different groups.**

Science Mom Lesson 90

Unit 8.6, Lesson 11: Notes Name ______________________

Creating Data Representations

Learning Goal(s):

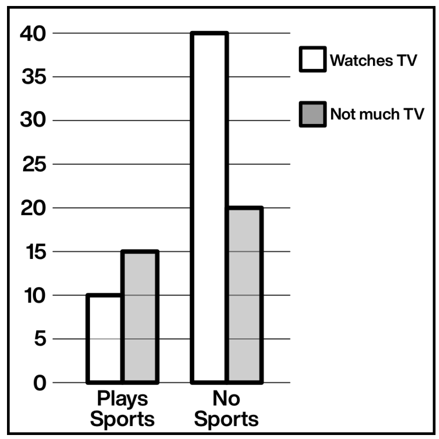
These data displays show the results of a survey of sports playing and TV watching of a group of students.

Fill in the missing information so that all of the data displays represent the same information.

Two-Way Table

	Watches TV	Not Much TV
Plays Sports	10	15
No Sports	40	20

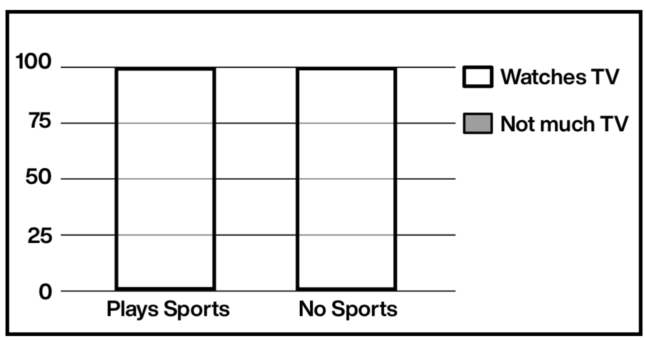
Bar Graph



Relative Frequency Table

	Watches TV	Not Much TV	Total
Plays Sports			
No Sports			

Segmented Bar Graph



Is there an association between playing sports and watching TV? Explain your thinking.

Summary Question

What are some things to remember when making relative frequency tables or segmented bar charts?

Unit 8.6, Lesson 11: Notes Name ____________________

Creating Data Representations

Learning Goal(s):
- **I can make relative frequency tables and segmented bar graphs from frequency tables.**
- **I can use a representation of data to decide if there is an association between two variables.**

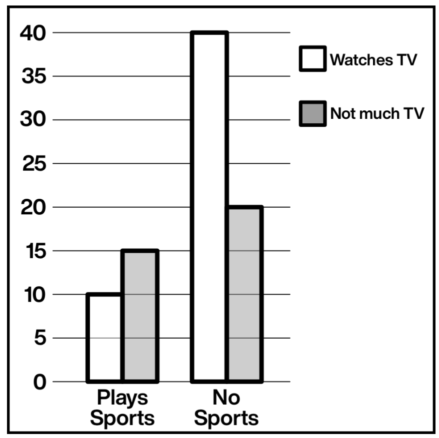
These data displays show the results of a survey of sports playing and TV watching of a group of students.

Fill in the missing information so that all of the data displays represent the same information.

Two-Way Table

	Watches TV	Not Much TV
Plays Sports	10	15
No Sports	40	20

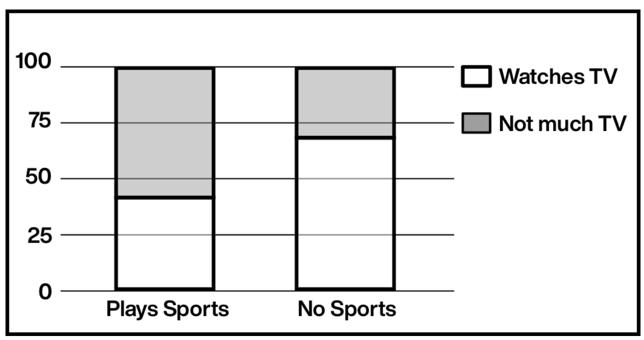
Bar Graph



Relative Frequency Table

	Watches TV	Not Much TV	Total
Plays Sports	40%	60%	100%
No Sports	66.7%	33.3%	100%

Segmented Bar Graph



Is there an association between playing sports and watching TV? Explain your thinking.
Responses vary. Yes. **The segmented bar graph helps me see that students who play a sport are less likely to watch TV (only 40%), and students who don't play a sport are more likely to watch TV (66.7%).**

Summary Question

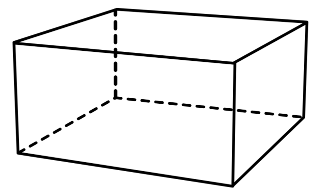
What are some things to remember when making relative frequency tables or segmented bar charts?
Responses vary. **Take your percentages based on the totals that you are looking at and make sure they add up to 100%. The axis labels in the segmented bar graph are the same as the totals in the relative frequency table.**

My Notes

1. Explain in your own words what a *cross section* is.

Here is a rectangular prism.

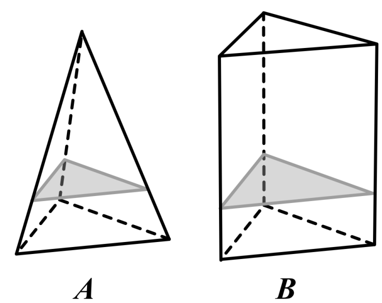
2. Select **all** the possible cross sections of this prism.



- ☐ Triangle
- ☐ Rectangle
- ☐ Pentagon
- ☐ Hexagon
- ☐ Octagon

Here is a triangular pyramid and a triangular prism.

3.1 If you cut both the pyramid and the prism parallel to their bases, how would the cross sections be **similar**?



3.2 How would they be **different**?

Summary

- ☐ I can describe cross sections of a solid.
- ☐ I can compare and contrast cross sections of prisms and pyramids.

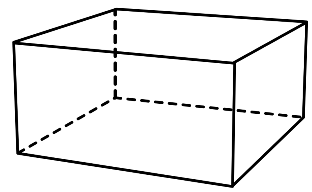
My Notes

1. Explain in your own words what a *cross section* is.

   ***Responses vary.* A cross section is a shape you see when you slice through a three-dimensional object.**

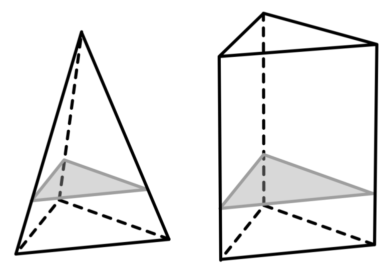
Here is a rectangular prism.

2. Select **all** the possible cross sections of this prism.



- ✓ Triangle
- ✓ Rectangle
- ✓ Pentagon
- ✓ Hexagon
- ☐ Octagon

Here is a triangular pyramid and a triangular prism.



3.1 If you cut both the pyramid and the prism parallel to their bases, how would the cross sections be **similar**?

Responses vary.

- **They are both triangles.**
- **They are both the same shape as the base.**
- **They both are scaled copies of the base.**

3.2 How would they be **different**? ***Responses vary.***

- **The cross section of the prism is the same size as its base. The cross section of the pyramid is smaller than its base.**
- **The cross section of the pyramid is almost always smaller than the cross section of the prism.**

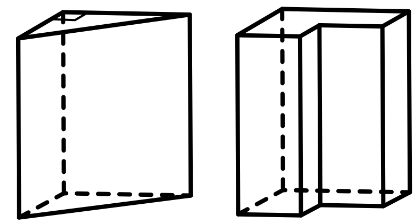
Summary

- ☐ I can describe cross sections of a solid.
- ☐ I can compare and contrast cross sections of prisms and pyramids.

Unit 7.7, Lesson 10: Notes Name ______________________________

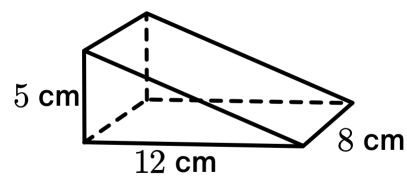
My Notes

1. Describe a strategy for calculating the volume of a prism.



2.1 Shade in a base of this prism.

2.2 Calculate the volume.
Show all of your calculations.



2.3 Sketch and label a **rectangular** prism with the same volume.

Summary

☐ I can explain how the volume of a prism is related to the area of its base and its height.

☐ I can calculate the volume of rectangular and triangular prisms.

desmos

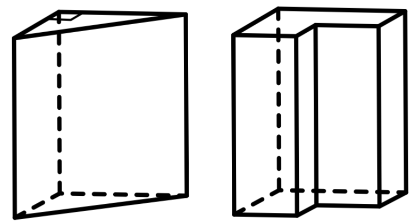
Unit 7.7, Lesson 10: Notes Name ______________________________

My Notes

1. Describe a strategy for calculating the *volume of a prism.*

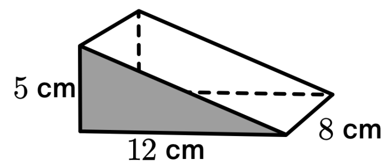
Responses vary.

- **Calculate the area of the base.**
- **Multiply that area by the height (the distance between the bases).**



2.1 Shade in a base of this prism.

2.2 Calculate the volume.
Show all of your calculations.



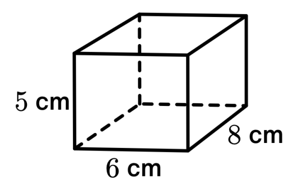
Volume = Base Area · Height

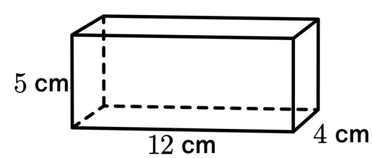
$V = \frac{1}{2}(5 \cdot 12) \cdot 8$

$V = 30 \cdot 8 = 240$ **cubic cm**

2.3 Sketch and label a **rectangular** prism with the same volume.

Responses vary.





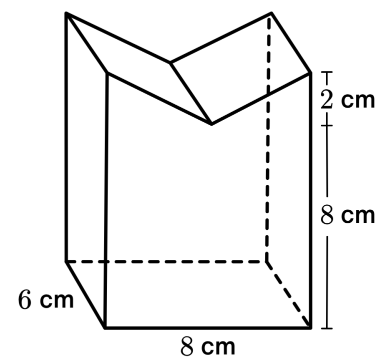
Summary

- ☐ I can explain how the volume of a prism is related to the area of its base and its height.
- ☐ I can calculate the volume of rectangular and triangular prisms.

Unit 7.7, Lesson 11: Notes Name ____________________

My Notes

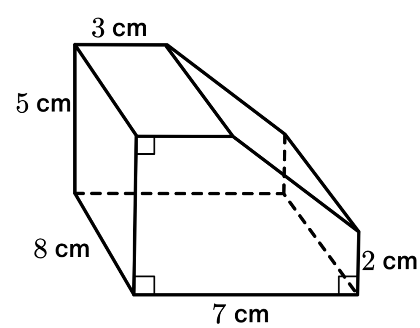
1.1 Sketch the base of this prism and label its dimensions.



1.2 What is the area of the base? Explain or show your reasoning.

1.3 What is the volume of the prism?

2. Use any strategy to calculate the volume of this prism.
Show all of your thinking.



Summary

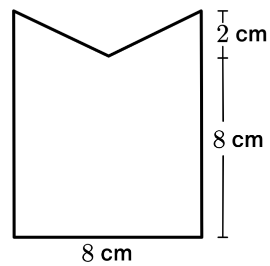
☐ I can calculate the volume of more complicated prisms.

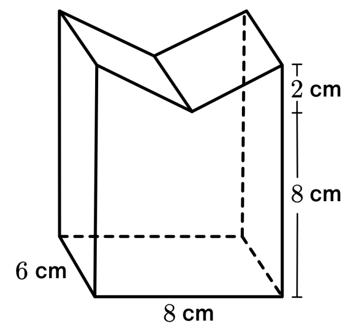
desmos

Unit 7.7, Lesson 11: Notes Name ______________________________

My Notes

1.1 Sketch the base of this prism and label its dimensions.





1.2 What is the area of the base? Explain or show your reasoning.

The base is made up of a square and two triangles.
The area of the square is $8 \cdot 8 = 64$ **square cm.**

The area of each triangle is $\frac{1}{2}(2 \cdot 4) = 4$ **square cm.**

In total, the area is $64 + 2(4) = 72$ **square cm.**

1.3 What is the volume of the prism?

Volume = Base Area • Height

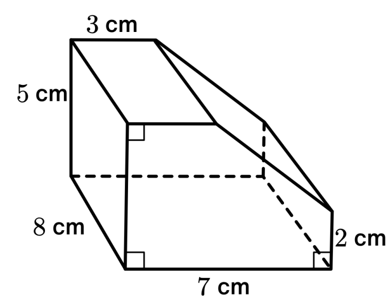
$V = 72 \cdot 6$
$V = 432$ **cubic cm**

2. Use any strategy to calculate the volume of this prism. Show all of your thinking.

Volume = Base Area • Height

Area = Rectangle – Triangle

$V = (7 \cdot 5 - 0.5 \cdot 4 \cdot 3)(8$
$V = (35 - 6)(8)$
$V = (29)(8)$
$V = 232$ **cubic cm**



Summary

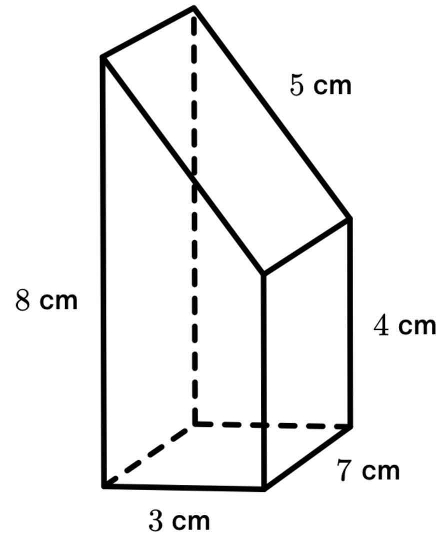
☐ I can calculate the volume of more complicated prisms.

desmos Science Mom Lesson 94

Unit 7.7, Lesson 12: Notes Name ______________________________

My Notes

Here is a prism.



1.1 How many faces does this prism have?

1.2 Sketch and label one of the bases.

1.3 Calculate the surface area of your prism.

1.4 Explain a strategy for calculating the surface area of this prism.

Summary

- ☐ I can calculate the surface area of a prism.
- ☐ I can compare and contrast different strategies for calculating surface area.

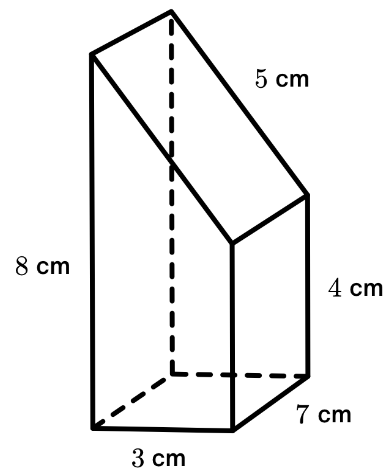
desmos

Unit 7.7, Lesson 12: Notes

Name ______________________

My Notes

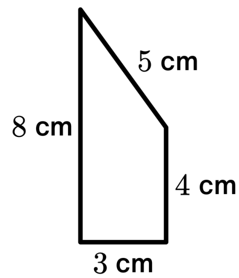
Here is a prism.



1.1 How many faces does this prism have?

6 **faces**

1.2 Sketch and label one of the bases.



1.3 Calculate the surface area of your prism. ***Strategies vary.***

- **SA =** $18 + 18 + 28 + 35 + 56 + 21 = 176$ **square units**
- **SA =** $2(18) + 1(28 + 35 + 56 + 21) = 176$ **square units**
- **SA** $= 2(18) + 7(4 + 5 + 8 + 3) = 176$ **square units**

1.4 Explain a strategy for calculating the surface area of this prism. ***Responses vary.***

- **Calculate the area of each face and add them together. Make sure you include two copies of the base.**
- **Calculate the area of each shape and then multiply by how many of that shape there are.**
- **Calculate the area of the big rectangle that wraps aroun the shape and add that to the area of the bases.**

Summary

- [ ] I can calculate the surface area of a prism.
- [ ] I can compare and contrast different strategies for calculating surface area.

Science Mom Lesson 95

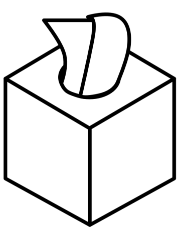
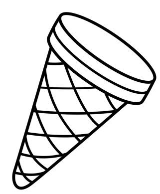
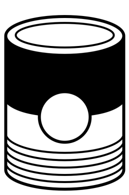
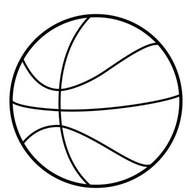
Unit 8.5, Lesson 10: Notes Name ______________________________

Exploring Volume

Learning Goal(s):

Definition	Facts/Characteristics
Volume	
Examples	Non-Examples

For each household object, name the 3-D solid it most resembles and a fact you learned today.

 Name: Fact:	 Name: Fact:
 Name: Fact:	 Name: Fact:

Summary Question

How would you describe volume to a 3rd grader?

desmos

Unit 8.5, Lesson 10: Notes Name ____________________________

Exploring Volume

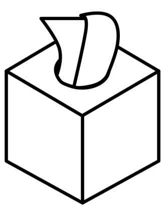
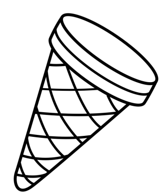
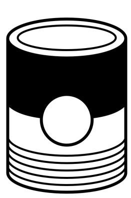
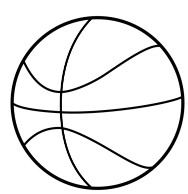
Learning Goal(s):

- **I recognize the following 3-D shapes: cylinder cone, rectangular prism, and sphere.**
- **I can estimate the volumes of different solids.**

Volume

Definition	Facts/Characteristics
The volume is the number of cubic units that fill a three-dimensional region without any gaps or overlaps.	**It is a 3-D measurement (e.g., cm^3)**
Examples	**Non-Examples**
A pitcher holds 5 gallons of water. **500 beans inside a jar.**	**The amount of wrapping paper on a present.** **Number of sides of a cube.**

For each household object, name the 3-D solid it most resembles and a fact you learned today.

	Name: **Cube** Fact: **Has the largest volume for specific dimensions.**		Name: **Cone** Fact: **Base shape is the same as a cylinder but comes to a point.**
	Name: **Cylinder** Fact: **Base shape is a circle.**		Name: **Sphere** Fact: **Only uses one measurement (radius) for all three dimensions.**

Summary Question
How would you describe volume to a 3rd grader?

Volume is the amount of space that a shape takes up. For example, with a cake, the volume is the amount of cake, not the amount of icing on top of the cake.

desmos Science Mom Lesson 96

Unit 8.5, Lesson 11: Notes Name ___________________________

The Volume of a Cylinder

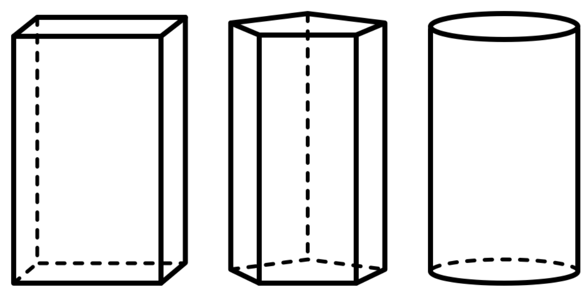
Learning Goal(s):

Here is the formula for the volume of a prism.

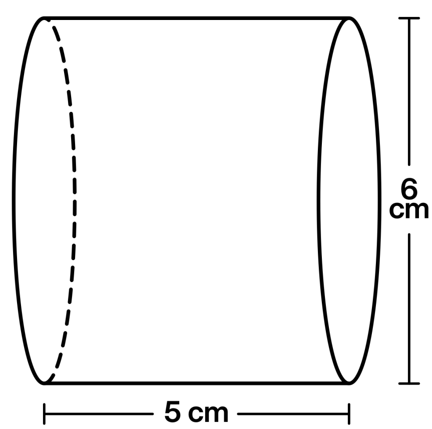
$$V = Bh$$

Explain what each of the variables mean.

Use these figures if it helps you explain your thinking.



Find the volume of the cylinder (exactly or rounded to the nearest tenth).



Summary Question

How is finding the volume of a cylinder like finding the volume of a prism?

Unit 8.5, Lesson 11: Notes Name ____________________

The Volume of a Cylinder

Learning Goal(s):

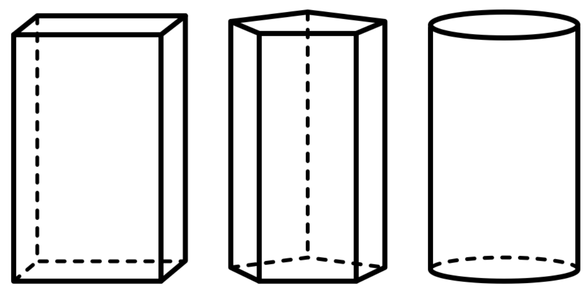
- **I can explain the parts of the formula for the volume of a cylinder.**
- **I can calculate the volume of a cylinder.**

Here is the formula for the volume of a prism.

$V = Bh$

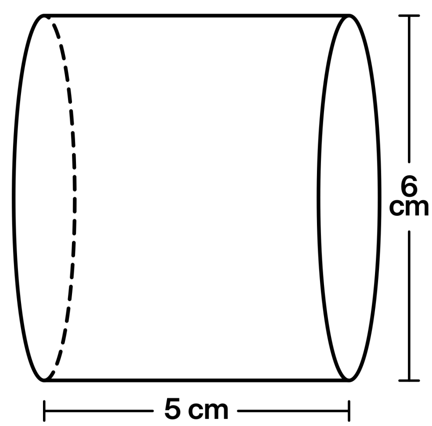
Explain what each of the variables mean.

Use these figures if it helps you explain your thinking.



V **represents the volume of a prism, which is found by multiplying the area of the base of the prism,** B**, by the height of the prism,** h**.**

Find the volume of the cylinder (exactly or rounded to the nearest tenth).



The base has an area of 9π **cm**^{2} **(since** $\pi \cdot 3^2 = 9\pi$**).**
The volume is 45π **cm**^{3} **(since** $9\pi \cdot 5 = 45\pi$**).**

Using 3.14 **as an approximation for** π**, the volume of the cylinder is approximately** 141.3 **cm**^{3}**.**

Summary Question

How is finding the volume of a cylinder like finding the volume of a prism?

Finding the volume of a cylinder is like finding the volume of a prism because they both involve finding the area of the base shape and multiplying that by the height.

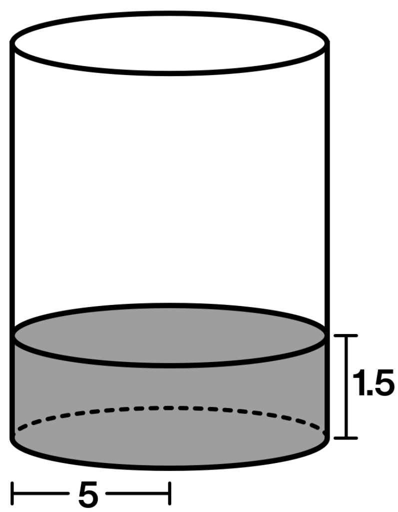
desmos Science Mom Lesson 97

Unit 8.5, Lesson 12: Notes Name ______________________________

Scaling Cylinders Using Functions

Learning Goal(s):

Imagine a water tank that is shaped like a cylinder.



If you triple the height of the water, will you triple the volume inside the container?

Yes No

Explain your thinking.

If you triple the radius of the water tank, will you triple the volume inside the container?

Yes No

Explain your thinking.

What are all of the ways you could change the water or the tank so that its volume is 4 times its current amount?

Summary Question

Why is the relationship between radius and volume non-linear?

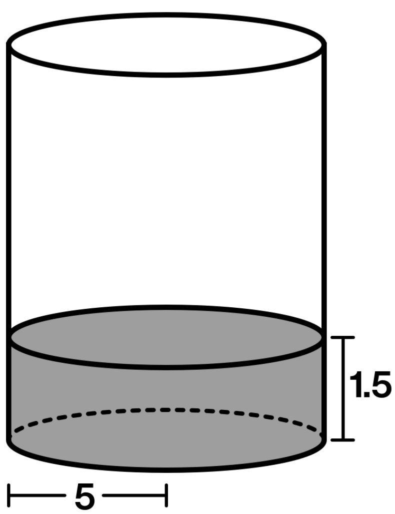
Unit 8.5, Lesson 12: Notes Name ______________________________

Scaling Cylinders Using Functions

Learning Goal(s):

- **I can analyze the relationship between the height or radius of a cylinder and its volume.**
- **I can explain why the relationship between height and volume is linear but the relationship between radius and volume is not.**

Imagine a water tank that is shaped like a cylinder.



If you triple the height of the water, will you triple the volume inside the container?

Yes No

Explain your thinking.

The relationship between the height and the volume of a cylinder is linear, so if you multiply the height by a scale factor, the volume will change by the same factor.

If you triple the radius of the water tank, will you triple the volume inside the container?

Yes **No**

Explain your thinking.

The relationship between the radius and the volume of a cylinder is not linear, so if you multiply the height by a scale factor, the volume will not change by the same scale factor.

What are all of the ways you could change the water or the tank so that its volume is 4 times its current amount?

You could multiply the height of the water by 4 or double the radius of the tank.

Summary Question

Why is the relationship between radius and volume non-linear?

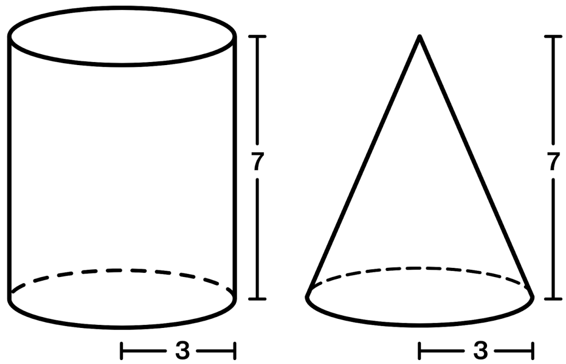
The radius of a cylinder represents 2 dimensions of the object (because the area of the circle involves r^2), so the relationship to volume is not linear. The height only represents 1 dimension of the object, so its relationship to volume is linear.

desmos **Science Mom Lesson 98**

Unit 8.5, Lesson 13: Notes Name ________________________

Volumes of Cones

Learning Goal(s):



Find the volume of the cylinder above.	Find the volume of the cone above.
Sketch a cone. Label the diameter 8 units and the height 5 units.	Find the volume of the cone whose diameter is 8 units and height is 5 units.

Summary Question

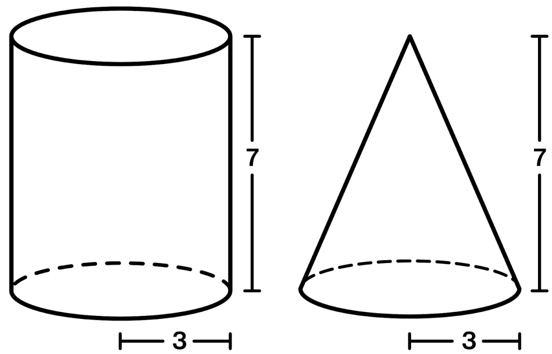
How would you explain the relationship between the volume of a cone and the volume of a cylinder to a 3rd grader?

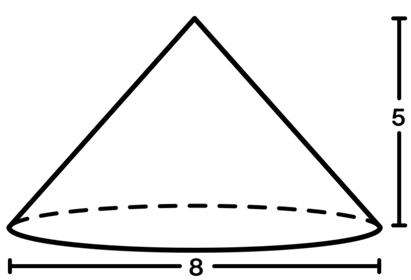
Unit 8.5, Lesson 13: Notes Name ____________________

Volumes of Cones

Learning Goal(s):

- **I can explain the relationship between the volume of a cone and the volume of a cylinder.**
- **I can use the formula for the volume of a cone.**



Find the volume of the cylinder above. **The volume of the cylinder is** 63π **cubic units. The area of the base is** $(3)^2 \cdot \pi = 9\pi$ **square units,** $9\pi \cdot 7 = 63\pi$**.**	Find the volume of the cone above. **The volume of the cone is** 21π **cubic units, which is** $\frac{1}{3}$ **the volume of a cylinder with the same radius and height.** $\frac{1}{3} \cdot 63\pi = 21\pi$**.**
Sketch a cone. Label the diameter 8 units and the height 5 units. 	Find the volume of the cone whose diameter is 8 units and height is 5 units. **The volume of the cone is** $\frac{80}{3}\pi$ **cubic units. This is** $\frac{1}{3}$ **the volume of a cylinder with the same radius and height. The volume of this cylinder is** $(4)^2 \cdot \pi \cdot 5 = 80\pi$**, so** $\frac{1}{3} \cdot 80\pi = \frac{80}{3}\pi$**.**

Summary Question

How would you explain the relationship between the volume of a cone and the volume of a cylinder to a 3rd grader?

If you filled a cone with water, you could pour 3 **cones full of water into** 1 **cylinder.**

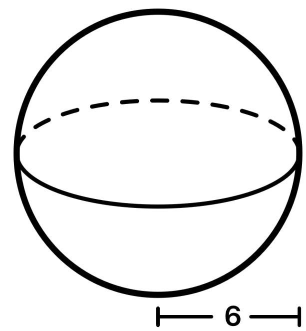
desmos **Science Mom Lesson 99**

Unit 8.5, Lesson 15: Notes Name ______________________________

Volumes of Spheres

Learning Goal(s):

Darryl, Na'ilah, and Maia calculated the volume of the sphere on the right. Each of them made an error in their calculations. Identify their errors and explain what they might have been thinking.



Darryl: $V = \frac{4}{3}\pi(6)^3 = \frac{4}{3}\pi(36) = 48\pi$ in.^{3}	Maia: $V = \frac{4}{3}\pi(6)^3 = \frac{4}{3}(18.84)^3 \approx 8196$ in.^{3}
Na'ilah: $V = \frac{4}{3}\pi(6)^3 = \frac{4}{3}\pi(18) = 24\pi$ in.^{3}	Find the volume of the sphere.

Summary Question

What advice would you give a student to help them find the volume of a sphere?

desmos

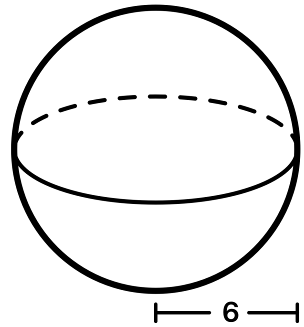
Unit 8.5, Lesson 15: Notes Name ______________________________

Volumes of Spheres

Learning Goal(s):

- **I can compare the volumes of a cone, a cylinder, a hemisphere, and a sphere.**
- **I can find the volume of a sphere when I know the radius or the diameter.**

Darryl, Na'ilah, and Maia calculated the volume of the sphere on the right. Each of them made an error in their calculations. Identify the error and explain what they might have been thinking.



Darryl: $V = \frac{4}{3}\pi(6)^3 = \frac{4}{3}\pi(36) = 48\pi$ in.^{3} **Darryl found the value of $(6)^2 = 6 \cdot 6$ instead of $(6)^3 = 6 \cdot 6 \cdot 6$.**	Maia: $V = \frac{4}{3}\pi(6)^3 = \frac{4}{3}(18.84)^3 \approx 8196$ in.^{3} **Maia multiplied the value for π by 6 before using the exponent $(\ )^3$.**
Na'ilah: $V = \frac{4}{3}\pi(6)^3 = \frac{4}{3}\pi(18) = 24\pi$ in.^{3} **Na'ilah found the value of $6 \cdot 3$, not $(6)^3$.**	Find the volume of the sphere. **The volume of the sphere is 288π in.^{3}.** $(6)^3 \cdot \pi = 216\pi$ **and** $\frac{4}{3} \cdot 216\pi = 288\pi$.

Summary Question

What advice would you give a student to help them find the volume of a sphere?

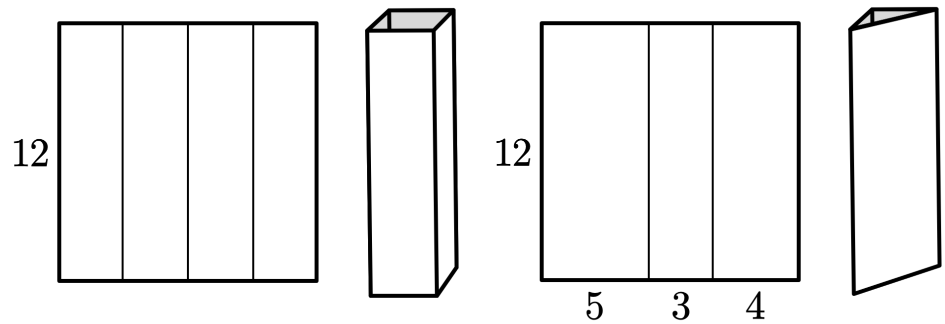
Make sure that you cube the radius first.
What it means to cube a number is to multiply the number by itself three times.

Science Mom Lesson 100

Unit 7.7, Lesson 13: Notes Name ____________________

My Notes

Imani is folding origami paper to make pencil holders for their room. They fold two holders: a square prism and a right triangular prism.



1. Which container holds more pencils? Calculate the amount each container can hold to support your claim.

2. Imani added a bottom and a top to each container. Which container do you think uses more paper? Calculate the amount of paper each container uses to support your claim.

Summary

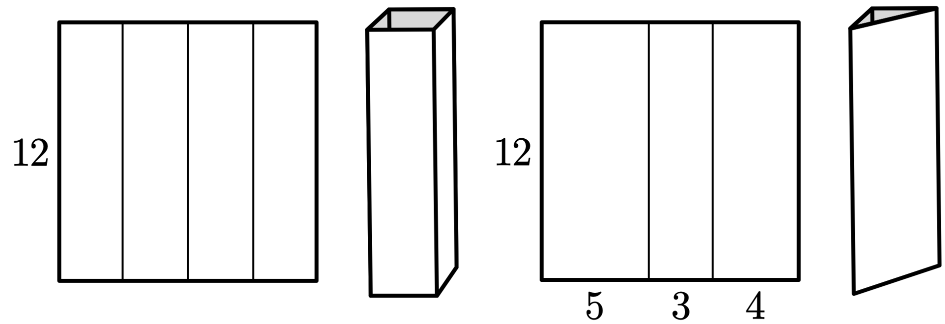
- ☐ I can decide whether volume or surface area is more useful to answer a question about a situation.
- ☐ I can answer a question about a real-world situation using my knowledge of surface area and volume.

desmos

Unit 7.7, Lesson 13: Notes Name ____________________

My Notes

Imani is folding origami paper to make pencil holders for their room. They fold two holders: a square prism and a right triangular prism.



1. Which container holds more pencils? Calculate the amount each container can hold to support your claim.
   The square prism.

   Explanations vary. **The base of the square pencil holder is 3-by-3 inches, so the area of its base is 9 square inches. The area of the base of the triangular pencil holder is $0.5 \cdot 4 \cdot 3 = 6$ square inches. Since both pencil holders are the same height, the square pencil holder has a larger volume and can hold more pencils.**

2. Imani added a bottom and a top to each container. Which container do you think uses more paper? Calculate the amount of paper each container uses to support your claim.
   The square prism.

   Explanations vary. **The amount of paper used for the side faces of each prism are the same since they are different ways of folding the same size paper. This means that the only difference is the area of the base. We already know the area of the base of the square is larger than the triangle, so it also must use more paper.**

Summary

- ☐ I can decide whether volume or surface area is more useful to answer a question about a situation.
- ☐ I can answer a question about a real-world situation using my knowledge of surface area and volume.

desmos **Science Mom Lesson 102**

Unit 8.7, Lesson 1: Notes Name ______________________________

Learning Goal(s):

Exponents make it easy to show repeated multiplication. It is easier to write 2^6 than to write $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$. Imagine writing 2^{100} using multiplication!

For each expression below, write an equivalent expression that uses exponents:

A. $7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	B. $5 \cdot 8 \cdot 5 \cdot 8 \cdot 5 \cdot 8 \cdot 5$	C. $10 \cdot 10 \cdot 10 + 10 \cdot 10$

Consider this situation: Each day, the number of grains of rice you have triples. On day one, you have 3 grains of rice. On day two, you have 9 grains of rice.

- On what day will you have 243 grains of rice?
- On what day will you have 3^{13} grains of rice?
- How many grains of rice will you have *two days after* you have 3^{13} grains of rice?

Summary Question

When is it useful to express a number or expression with exponents?

desmos

Unit 8.7, Lesson 1: Notes Name ____________________

Learning Goal(s):

- **I can use exponents to describe repeated multiplication.**
- **I can explain the meaning of an expression with an exponent.**

Exponents make it easy to show repeated multiplication. It is easier to write 2^6 than to write $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$. Imagine writing 2^{100} using multiplication!

For each expression below, write an equivalent expression that uses exponents:

A. $7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	B. $5 \cdot 8 \cdot 5 \cdot 8 \cdot 5 \cdot 8 \cdot 5$	C. $10 \cdot 10 \cdot 10 + 10 \cdot 10$
7^5	$5^4 \cdot 8^3$ **or equivalent**	$10^3 + 10^2$ **or equivalent**

Consider this situation: Each day, the number of grains of rice you have triples. On day one, you have 3 grains of rice. On day two, you have 9 grains of rice.

- On what day will you have 243 grains of rice?

Day five. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 243$**, so you will have** 243 **grains of rice on day five.**

- On what day will you have 3^{13} grains of rice?

Day thirteen. Day one had 3^1 **grains of rice. Day two had** 3^2 **grains of rice. Continuing the pattern, the day that will have** 3^{13} **grains of rice will be day thirteen.**

- How many grains of rice will you have *two days after* you have 3^{13} grains of rice?

3^{15} **grains of rice. This is** 9 **times more than** 3^{13}**.**

Summary Question

When is it useful to express a number or expression with exponents?

Responses vary. **Exponents are especially useful when we have an expression with a lot of repeated multiplication.**

desmos Science Mom Lesson 103

Unit 8.7, Lesson 2: Notes Name ______________________________

Learning Goal(s):

Sometimes writing an expression in an equivalent way can help us compare it to other expressions. The fact that exponents represent repeated multiplication can help us write equivalent expressions.

Decide if Expression 1 is equivalent to Expression 2 for each pair. Consider "expanding" each expression, as shown in Pair A.

	Expression 1	Expression 2	Equivalent?
Pair A	$\left(12^2\right)^3$ $(12 \cdot 12)(12 \cdot 12)(12 \cdot 12)$	$12^4 \cdot 12^2$ $(12 \cdot 12 \cdot 12 \cdot 12)(12 \cdot 12)$	YES NO
Pair B	$7^3 \cdot 2^3$	$(7 \cdot 2)^3$	YES NO
Pair C	$16^3 + 16^2 + 16$	16^6	YES NO
Pair D	15^6	$(5 \cdot 3 \cdot 3 \cdot 5)^4$	YES NO

Summary Question

Show or explain why $6^5 \cdot 6^3$ is equivalent to $\left(6^4\right)^2$. Then write another expression that is equivalent to both of them.

desmos

Unit 8.7, Lesson 2: Notes Name ______________________________

Learning Goal(s):
- **I can describe what it means for two expressions with exponents to be equivalent.**
- **I can create equivalent expressions with exponents.**

Sometimes writing an expression in an equivalent way can help us compare it to other expressions. The fact that exponents represent repeated multiplication can help us write equivalent expressions.

Decide if Expression 1 is equivalent to Expression 2 for each pair. Consider "expanding" each expression, as shown in Pair A.

	Expression 1	Expression 2	Equivalent?
Pair A	$\left(12^2\right)^3$ $(12 \cdot 12)(12 \cdot 12)(12 \cdot 12)$	$12^4 \cdot 12^2$ $(12 \cdot 12 \cdot 12 \cdot 12)(12 \cdot 12)$	**YES** NO
Pair B	$7^3 \cdot 2^3$ $7 \cdot 7 \cdot 7 \cdot 2 \cdot 2 \cdot 2$	$(7 \cdot 2)^3$ $(7 \cdot 2)\cdot(7 \cdot 2)\cdot(7 \cdot 2)$	**YES** NO
Pair C	$16^3 + 16^2 + 16$ $16 \cdot 16 \cdot 16 + 16 \cdot 16 + 16$	16^6 $16 \cdot 16 \cdot 16 \cdot 16 \cdot 16 \cdot 16$	YES **NO**
Pair D	15^6 $15 \cdot 15 \cdot 15 \cdot 15 \cdot 15 \cdot 15$	$(5 \cdot 3 \cdot 3 \cdot 5)^4$ $(15 \cdot 15)(15 \cdot 15)(15 \cdot 15)(15$	YES **NO**

Summary Question

Show or explain why $6^5 \cdot 6^3$ is equivalent to $\left(6^4\right)^2$. Then write another expression that is equivalent to both of them.

Responses vary. $6^5 \cdot 6^3$ **is eight factors of** 6**. The expression** $\left(6^4\right)^2$ **is also eight factors of** 6**.**

Another equivalent expression is: $\left(6^2\right)^4$**.**

desmos Science Mom Lesson 104

Unit 8.7, Lesson 4: Notes Name ______________________________

Learning Goal(s):

Expressions that have a single base and a single exponent (like 7^3) are sometimes preferable to expressions with more parts because they can help us easily compare numbers to each other.

For each expression below, fill in the blanks. The first row has been done for you.

Expression	Expanded Expression	Single Power
$\left(12^2\right)^3$	$(12 \cdot 12)(12 \cdot 12)(12 \cdot 12)$	12^6
A. $\frac{6^5 \cdot 6^2}{6^4}$		
B. $7^3 \cdot 2^3$		
C. $\frac{\left(3^3\right)^2}{3^4}$		
D. $\frac{9^2 \cdot 3^5}{3^3}$		

Which of the four above expressions (A, B, C, or D) is greatest? Explain your reasoning.

Summary Question

Describe a strategy for rewriting an expression like $\frac{\left(6^{30}\right)^3}{6^{40}}$ as a single power.

desmos

Unit 8.7, Lesson 4: Notes Name ____________________

Learning Goal(s):

- **I can divide expressions with exponents that have the same base.**
- **I can rewrite expressions with positive exponents as a single power.**

Expressions that have a single base and single exponent (like 7^3) are sometimes preferable to expressions with more parts because they can help us easily compare numbers to each other.

For each expression below, fill in the blanks. The first row has been done for you.

Expression	Expanded Expression	Single Power
$\left(12^2\right)^3$	$(12 \cdot 12)(12 \cdot 12)(12 \cdot 12)$	12^6
A. $\dfrac{6^5 \cdot 6^2}{6^4}$	$\dfrac{(6 \cdot 6 \cdot 6 \cdot 6 \cdot 6) \cdot (6 \cdot 6)}{6 \cdot 6 \cdot 6 \cdot 6}$	6^3
B. $7^3 \cdot 2^3$	$7 \cdot 7 \cdot 7 \cdot 2 \cdot 2 \cdot 2 \rightarrow 7 \cdot 2 \cdot 7 \cdot 2 \cdot 7 \cdot 2$	14^3
C. $\dfrac{\left(3^3\right)^2}{3^4}$	$\dfrac{(3 \cdot 3 \cdot 3)(3 \cdot 3 \cdot 3)}{3 \cdot 3 \cdot 3 \cdot 3}$	3^2
D. $\dfrac{9^2 \cdot 3^5}{3^3}$	$\dfrac{(9 \cdot 9) \cdot (3 \cdot 3 \cdot 3 \cdot 3 \cdot 3)}{3 \cdot 3 \cdot 3} \rightarrow \dfrac{(3 \cdot 3 \cdot 3 \cdot 3) \cdot (3 \cdot 3 \cdot 3 \cdot 3 \cdot 3)}{3 \cdot 3 \cdot 3}$	3^6

Which of the four above expressions (A, B, C, or D) is greatest? Explain your reasoning.

B is greatest of the four. *Responses vary*. A cannot be the greatest expression because $6^3 < 14^3$. C cannot be the greatest expression because $3^2 < 3^6$. I know I can rewrite 3^6 as 9^3, which helps me see that $9^3 < 14^3$.

Summary Question

Describe a strategy for rewriting an expression like $\dfrac{\left(6^{30}\right)^3}{6^{40}}$ as a single power.

***Responses vary*. If the numbers are small, I like to write out every factor of an expression. Then I reduce factors that are in both the numerator and denominator. If the numbers are large, like in this expression, I *imagine* writing out every factor. E.g., 30 factors of 6 three times will make 90 factors of 6.**

desmos Science Mom Lesson 105

Unit 8.7, Lesson 5: Notes Name ________________________________

Learning Goal(s):

Our concept of "exponents as repeated multiplication" is less helpful when the exponent is zero or a negative number. Patterns can help us discover what zero or negative numbers mean as exponents.

Powers of 8		
8^3	$1 \cdot 8 \cdot 8 \cdot 8$	512
8^2	$1 \cdot 8 \cdot 8$	64
8^1	$1 \cdot 8$	8
8^0	1	1
8^{-1}	$1 \div 8$	$\frac{1}{8}$
8^{-2}	$1 \div 8 \div 8$	$\frac{1}{8^2}$ or $\frac{1}{64}$
8^{-3}	$1 \div 8 \div 8 \div 8$	$\frac{1}{8^3}$ or $\frac{1}{512}$

Examine the **Powers of 8** table. How do the numbers change as you look *down* the table from 8^3 to 8^2 to 8^1?

Based on the patterns in the table, what is another way to represent 8^{-5}?

Why does it make sense that $8^0 = 1$?

Write each expression as a single power:

A. $\dfrac{7^4 \cdot 7^{-2}}{7^{12}}$

B. $\frac{1}{5} \cdot \frac{1}{5} \cdot \frac{1}{5}$

C. $\dfrac{2^{-4}}{\left(2^{-5}\right)^2}$

Summary Questions

What is the relationship between 10^5 and 10^{-5}?

What is the value of $10^5 \cdot 10^{-5}$?

Unit 8.7, Lesson 5: Notes Name ______________________

Learning Goal(s):

- **I can explain what it means for a number to be raised to a zero or a negative exponent.**
- **I can determine if two expressions with positive, zero, and negative exponents are equivalent.**

Our concept of "exponents as repeated multiplication" is less helpful when the exponent is zero or a negative number. Patterns can help us discover what zero or negative numbers mean as exponents.

Powers of 8		
8^3	$1 \cdot 8 \cdot 8 \cdot 8$	512
8^2	$1 \cdot 8 \cdot 8$	64
8^1	$1 \cdot 8$	8
8^0	1	1
8^{-1}	$1 \div 8$	$\frac{1}{8}$
8^{-2}	$1 \div 8 \div 8$	$\frac{1}{8^2}$ or $\frac{1}{64}$
8^{-3}	$1 \div 8 \div 8 \div 8$	$\frac{1}{8^3}$ or $\frac{1}{512}$

Examine the **Powers of 8** table. How do the numbers change as you look *down* the table from 8^3 to 8^2 to 8^1?

As we go down the table, each number is one-eighth the previous number.

Based on the patterns in the table, what is another way to represent 8^{-5}?

$\frac{1}{8^5}$ **(or equivalent)**

Why does it make sense that $8^0 = 1$?

***Responses vary*. If we continue the pattern of dividing by 8, then the row below $8^1 = 8$ should say $8^0 = 1$.**

Write each expression as a single power:

A. $\dfrac{7^4 \cdot 7^{-2}}{7^{12}}$

7^{-10}

B. $\frac{1}{5} \cdot \frac{1}{5} \cdot \frac{1}{5}$

5^{-3} **or** $\left(\frac{1}{5}\right)^3$

C. $\dfrac{2^{-4}}{\left(2^{-5}\right)^2}$

2^6

Summary Questions

What is the relationship between 10^5 and 10^{-5}?

***Responses vary.* The two numbers are reciprocals. 10^5 is 1 multiplied by 10 five times, while 10^{-5} is 1 divided by 10 five times.**

What is the value of $10^5 \cdot 10^{-5}$?

$10^5 \cdot 10^{-5}$ **is the same as** $10^5 \cdot \frac{1}{10^5}$**, which is** $\frac{10^5}{10^5}$**, which is** 1.

desmos Science Mom Lesson 106

Unit 8.7, Lesson 7: Notes Name ____________________

Learning Goal(s):

The United States Mint has made over $500,000,000,000$ pennies. Exactly how many pennies is that? One way to make sense of that number is by considering how many thousands, millions, or billions of pennies that is. Another way of making sense is to rewrite it using powers of 10.

Number	In Billions	In Millions	In Thousands	Rewrite as a Multiple of a Power of 10
$500,000,000,000$	____ billion (10^9)			
$500,000,000,000$		____ million (10^6)		
$500,000,000,000$			____ thousand (10^3)	

Write two different expressions that represent the weight of the object using a power of ten.

Object and Weight	Expression #1	Expression #2
Bus: $7,810$ **kg**	$781 \cdot 10^1$	
Ship: $4,850,000$**kg**		
Cell Phone: 0.13 **kg**		

Summary Question

What does it mean to write a number using a single multiple of a power of 10?

desmos

Unit 8.7, Lesson 7: Notes Name ______________________________

Learning Goal(s):

- **I can represent large and small numbers as multiples of powers of 10.**

The United States Mint has made over $500,000,000,000$ pennies. Exactly how many pennies is that? One way to make sense of that number is by considering how many thousands, millions, or billions of pennies that is. Another way of making sense is to rewrite it using powers of 10.

Number	**In Billions**	**In Millions**	**In Thousands**	**Rewrite as a Multiple of a Power of 10**
$500,000,000,000$	500 billion (10^9)			$500 \cdot 10^9$
$500,000,000,000$		$500,000$ million (10^6)		$500,000 \cdot 10^6$
$500,000,000,000$			$500,000,000$ thousand (10^3)	$500,000,000 \cdot 10^3$

Write two different expressions that represent the weight of the object using a power of ten.

Object and Weight	**Expression #1**	**Expression #2**
Bus: $7,810$ **kg**	$781 \cdot 10^1$	$7.81 \cdot 10^3$
Ship: $4,850,000$ **kg**	$485 \cdot 10^4$	$4.85 \cdot 10^6$
Cell Phone: 0.13 **kg**	$13 \cdot 10^{-2}$	$1.3 \cdot 10^{-1}$

Summary Question

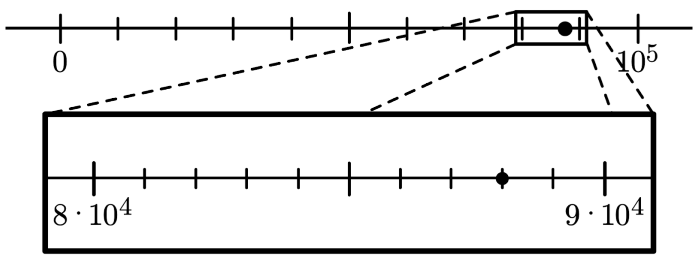
What does it mean to write a number using a single multiple of a power of 10?

***Responses vary.* It means that I multiply a first factor by a second factor that is 10 raised to a power. When I multiply the first and second factor, I will get the original number.**

Unit 8.7, Lesson 8: Notes Name ____________________________________

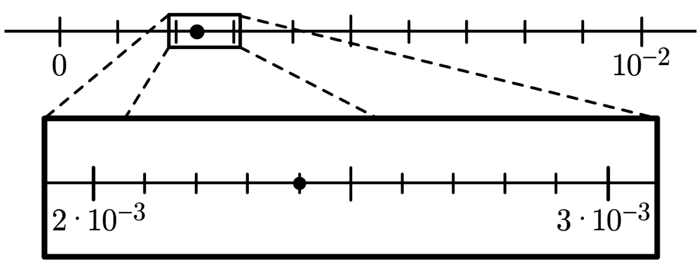
Learning Goal(s):

For each example below, write the number shown on the number line diagram.



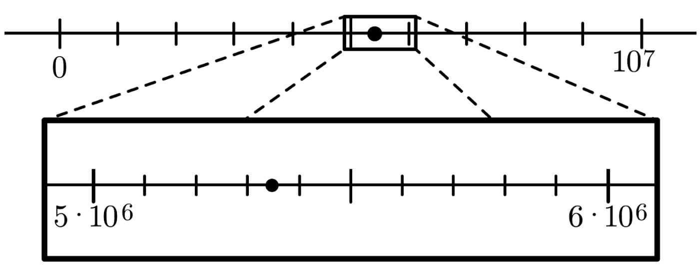
Write the number shown on the number line diagram.

What is another way to write this number?



Write the number shown on the number line diagram.

What is another way to write this number?



Write the number shown on the number line diagram.

What is another way to write this number?

Summary Question

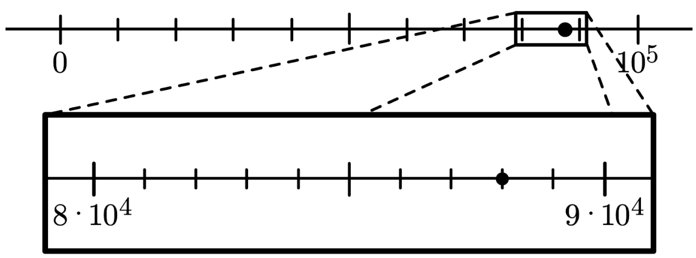
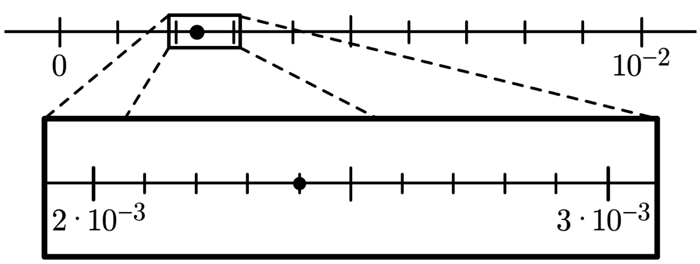
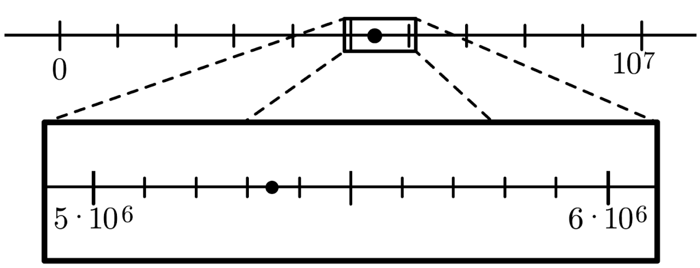
When a number is given as a multiple of a power of 10, what is a strategy for writing an equivalent number?

desmos

Unit 8.7, Lesson 8: Notes Name ______________________________

Learning Goal(s): • **I can represent large and small numbers as multiples of powers of 10 using number lines.**

For each example below, write the number shown on the number line diagram.

	Write the number shown on the number line diagram. $8.8 \cdot 10^4$ What is another way to write this number? $88,000$ **or equivalent**
	Write the number shown on the number line diagram. $2.4 \cdot 10^{-3}$ What is another way to write this number? $\frac{24}{10{,}000}$ **or equivalent**
	Write the number shown on the number line diagram. $5.35 \cdot 10^6$ What is another way to write this number? $5,350,000$ **or equivalent**

Summary Question

When a number is given as a multiple of a power of 10, what is a strategy for writing an equivalent number?

Responses vary. **You can use repeated multiplication to write out the expression, and then multiply all of the factors to find the number in standard form.**

desmos Science Mom Lesson 108

Unit 8.7, Lesson 9: Notes Name ____________________

Learning Goal(s):

Powers of 10 and exponent rules can be helpful for making calculations with large or small numbers. The table below shows the number of people in the United States in 2014 and how much total oil they used for energy.

	Estimated Amount	**Write Using a Power of 10**
Population of United States in 2014	$300,000,000$ people	
Total Oil Used	$2,000,000,000,000$ kilograms	

Approximately how many kilograms of oil did the average person in the United States use in 2014?

The table shows the total number of creatures as well as the approximate masses of each creature.

Creature	**Total**	**Mass of One Individual (kg)**
Humans	$7.5 \cdot 10^9$	$6 \cdot 10^1$
Ants	$5 \cdot 10^{16}$	$3 \cdot 10^{-6}$

Which is more massive: the total mass of all humans or the total mass of all the ants? About how many times more massive is it?

Summary Question

If you have two very large numbers, how can you tell which is larger?

desmos

Unit 8.7, Lesson 9: Notes Name ______________________________

Learning Goal(s):

- **I can apply what I learned about powers of 10 to answer questions about real-world situations.**

Powers of 10 and exponent rules can be helpful for making calculations with large or small numbers. The table below shows the number of people in the United States in 2014 and how much total oil they used for energy.

	Estimated Amount	**Write Using a Power of 10**
Population of United States in 2014	$300,000,000$ people	$3 \cdot 10^8$
Total Oil Used	$2,000,000,000,000$ kilograms	$2 \cdot 10^{12}$

Approximately how many kilograms of oil did the average person in the United States use in 2014?

$$\frac{2 \cdot 10^{12}}{3 \cdot 10^8} = \frac{2}{3} \cdot 10^4 \approx 0.66 \cdot 10^4,$$

which is about $6,600$ kilograms of oil per person on average.

The table shows the total number of creatures as well as the approximate masses of each creature.

Creature	**Total**	**Mass of One Individual (kg)**
Humans	$7.5 \cdot 10^9$	$6 \cdot 10^1$
Ants	$5 \cdot 10^{16}$	$3 \cdot 10^{-6}$

Which is more massive: the total mass of all humans or the total mass of all the ants? About how many times more massive is it?

Total Mass of Humans:

$(7.5 \cdot 10^9)(6 \cdot 10^1)$
$= 45 \cdot 10^{10}$ **kilograms**

Total Mass of Ants:

$(5 \cdot 10^{16})(3 \cdot 10^{-6})$
$= 15 \cdot 10^{10}$ **kilograms**

How Many Times More Massive?

$$\frac{45 \cdot 10^{10}}{15 \cdot 10^{10}} \approx 3$$

The total mass of all humans is $45 \cdot 10^{10}$ kilograms. That's 3 times as much as the total mass of all the ants, which is $15 \cdot 10^{10}$ kilograms.

Summary Question

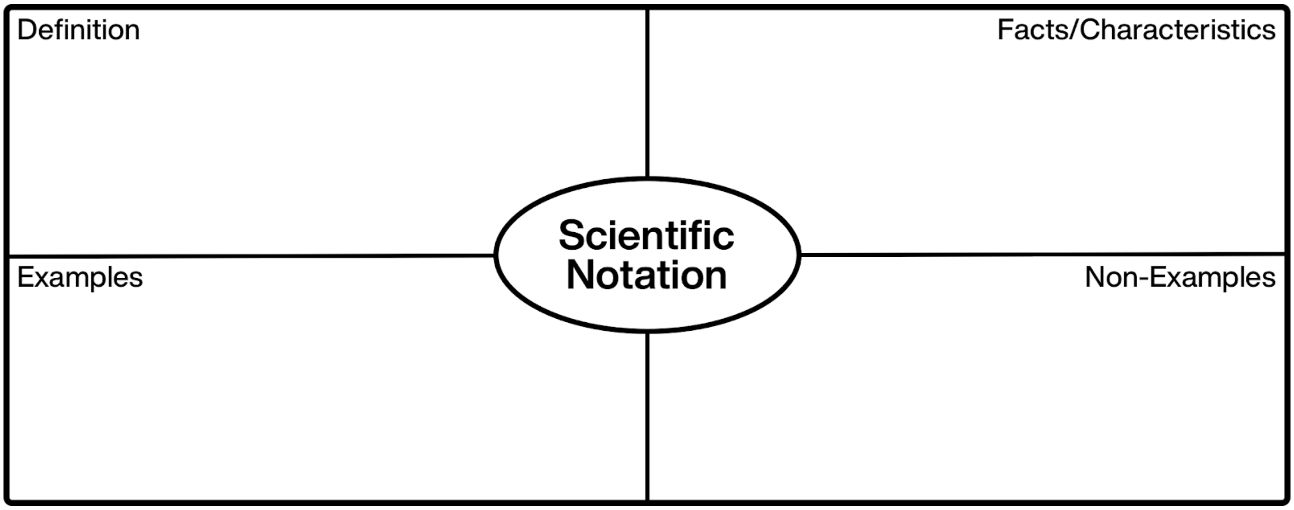
If you have two very large numbers, how can you tell which is larger?

Responses vary. **If you rewrite the numbers using the same power of 10, the number with the larger first factor is larger.**

desmos **Science Mom Lesson 109**

Unit 8.7, Lesson 10: Notes Name ____________________________________

Learning Goal(s):



Write each number using scientific notation, or say if it is already written using scientific notation.

Number	Scientific Notation
$540{,}000$	
0.003	
$6.8 \cdot 10^{9}$	
$12 \cdot 10^{-2}$	
$97 \cdot 10^{5}$	

Summary Question

What is important to pay attention to when writing a number in scientific notation?

desmos

Unit 8.7, Lesson 10: Notes Name ____________________

Learning Goal(s):

- **I can tell whether or not a number is written in scientific notation.**
- **I can rewrite a large or small number using scientific notation.**

Definition	Facts/Characteristics
Scientific notation is a way to write numbers (often very large or very small ones). We write them as a number between 1 and 10 multiplied by a power of 10.	- Scientific notation can help us compare very large or very small numbers. - The power of 10 has to be an integer.
Examples	**Non-Examples**
$5.23 \cdot 10^8$ $8.7 \cdot 10^{12}$ $3 \cdot 10^2$	$48\,200$ $36 \cdot 10^5$ $0.781 \cdot 10^3$

Scientific Notation

Write each number using scientific notation, or say if it is already written using scientific notation.

Number	Scientific Notation
$540{,}000$	$5.4 \cdot 10^5$
0.003	$3 \cdot 10^{-3}$
$6.8 \cdot 10^9$	**Already in scientific notation**
$12 \cdot 10^{-2}$	$1.2 \cdot 10^{-1}$
$97 \cdot 10^5$	$9.7 \cdot 10^6$

Summary Question

What is important to pay attention to when writing a number in scientific notation?

Responses vary. **Make sure the first factor is greater than or equal to 1 and less than 10. The second factor should be an integer power of 10.**

desmos Science Mom Lesson 110

Unit 8.7, Lesson 11: Notes Name ____________________________________

Learning Goal(s):

Comparing the relative sizes of very large or very small numbers is easier with scientific notation. The table shows the total numbers of humans and ants.

	Approximate Number	Scientific Notation
Humans	$7,500,000,000$	
Ants	$50,000,000,000,000,000$	

About how many ants are there for every human?

Ants weigh about $3 \cdot 10^{-6}$ kilograms each. Humans weigh about $6.2 \cdot 10^{1}$ kilograms each. About how many ants weigh the same as one human?

There are about $3.9 \cdot 10^{7}$ residents in California. The average Californian uses about 180 gallons of water per day. About how many gallons of water total do Californians use in a day?

Summary Question

Describe a strategy you used to divide two numbers given in scientific notation.

desmos

Unit 8.7, Lesson 11: Notes Name ___________________________________

Learning Goal(s):

- **I can use scientific notation and estimation to compare very large or very small numbers.**
- **I can multiply and divide numbers given in scientific notation.**

Comparing the relative sizes of very large or very small numbers is easier with scientific notation. The table shows the total number of humans and ants.

	Approximate Number	Scientific Notation
Humans	7 500 000 000	$7.5 \cdot 10^9$
Ants	50 000 000 000 000 000	$5 \cdot 10^{16}$

About how many ants are there for every human?

$\frac{5 \cdot 10^{16}}{7.5 \cdot 10^9} \approx 0.67 \cdot 10^7$**, which is about** 6.7 **million ants per human.**

Ants weigh about $3 \cdot 10^{-6}$ kilograms each. Humans weigh about $6.2 \cdot 10^1$ kilograms each. About how many ants weigh the same as one human?

$\frac{6.2 \cdot 10^1}{3 \cdot 10^{-6}} \approx 2 \cdot 10^7$**, so about** 20 **million ants weigh the same as one human.**

There are about $3.9 \cdot 10^7$ residents in California. The average Californian uses about 180 gallons of water per day. About how many gallons of water total do Californians use in a day?

$\left(3.9 \cdot 10^7\right)\left(1.8 \cdot 10^2\right) \approx 8 \cdot 10^9$**, so Californians use about** 8 **billion gallons of water in a day.**

Summary Question

Describe a strategy you used to divide two numbers given in scientific notation.

Responses vary. **I rounded each of the first factors and divided them. I also divided the powers of** 10 **using exponent properties. My final answer is those two numbers multiplied together.**

Name ___________________________________

desmos Science Mom Lesson 111

Unit 8.7, Lesson 12: Notes Name ___________________________________

Learning Goal(s):

The table below shows the diameters for objects in our solar system.

Object	Diameter (km)
Sun	$1.392 \cdot 10^6$
Mars	$6.785 \cdot 10^3$
Jupiter	$1.428 \cdot 10^5$
Neptune	$4.95 \cdot 10^4$
Saturn	$1.2 \cdot 10^5$

If we place Mars and Neptune next to each other, are they wider than Saturn?

First, add the diameters of Mars and Neptune:

$$6.785 \cdot 10^3 + 4.95 \cdot 10^4$$

To add these numbers, we can either rewrite them as multiples of 10^3 or as multiples of 10^4.

Method 1: Rewrite each number as a multiple of 10^3.

Method 2: Rewrite each number as a multiple of 10^4.

If we place Jupiter and Neptune next to each other, are they wider than the Sun?

About how much wider is Jupiter than Neptune?

Summary Question

What are some important things to remember when adding numbers written in scientific notation?

desmos

Unit 8.7, Lesson 12: Notes Name ____________________

Learning Goal(s):

- **I can add and subtract numbers given in scientific notation.**

The table below shows the diameters for objects in our solar system.

Object	Diameter (km)
Sun	$1.392 \cdot 10^6$
Mars	$6.785 \cdot 10^3$
Jupiter	$1.428 \cdot 10^5$
Neptune	$4.95 \cdot 10^4$
Saturn	$1.2 \cdot 10^5$

If we place Mars and Neptune next to each other, are they wider than Saturn?

First, add the diameters of Mars and Neptune:

$6.785 \cdot 10^3 + 4.95 \cdot 10^4$

To add these numbers, we can either rewrite them as multiples of 10^3 or as multiples of 10^4.

Method 1: Rewrite each number as a multiple of 10^3.

$6.785 \cdot 10^3 + 49.5 \cdot 10^3 = 56.285 \cdot 10^3$ **or about** $5.6 \cdot 10^4$ **km, which is not wider than Saturn.**

Method 2: Rewrite each number as a multiple of 10^4.

$0.6785 \cdot 10^4 + 4.95 \cdot 10^4 = 5.6285 \cdot 10^4$ **km, which is not wider than Saturn.**

If we place Jupiter and Neptune next to each other, are they wider than the Sun?

$1.428 \cdot 10^5 + 4.95 \cdot 10^4$
$= 14.28 \cdot 10^4 + 4.95 \cdot 10^4$**, which is about** $19 \cdot 10^4$ **or** $1.9 \cdot 10^5$ **km. They are not wider than the Sun.**

About how much wider is Jupiter than Neptune?

$1.428 \cdot 10^5 - 4.95 \cdot 10^4$
$\approx 14 \cdot 10^4 - 5 \cdot 10^4$
$= 9 \cdot 10^4$
Jupiter is about $90,000$ **km wider than Neptune.**

Summary Question
What are some important things to remember when adding numbers written in scientific notation?

Responses vary. **Make sure the powers of** 10 **are the same. To rewrite a number with a different power of ten, multiply the first factor by** 10 **to make the exponent smaller by** 1**, or divide the first factor by** 10 **to make the exponent larger by** 1**.**

desmos **Science Mom Lesson 112**

Unit 8.7, Lesson 13: Notes Name ________________________________

Learning Goal(s):

Use the table to answer questions about different life forms on our planet.

Creature	Number	Mass of One Individual (kg)
Humans	$7.5 \cdot 10^{9}$	$6.2 \cdot 10^{1}$
Sheep	$1.75 \cdot 10^{9}$	$6 \cdot 10^{1}$
Chickens	$2.4 \cdot 10^{10}$	$2 \cdot 10^{0}$
Antarctic Krill	$7.8 \cdot 10^{14}$	$4.86 \cdot 10^{-4}$
Bacteria	$5 \cdot 10^{30}$	$1 \cdot 10^{-12}$

Which is larger: the total mass of all humans or of all the Antarctic krill?

How can you tell which creature has the greatest total mass?

About how many more chickens are there than sheep?

Summary Question

What are some important things to remember about adding, subtracting, multiplying, and dividing numbers written in scientific notation?

desmos

Unit 8.7, Lesson 13: Notes Name ___________________________

Learning Goal(s):

- **I can use scientific notation to compare different quantities and answer questions about real-world situations.**

Use the table to answer questions about different life forms on our planet.

Creature	Number	Mass of One Individual (kg)
Humans	$7.5 \cdot 10^{9}$	$6.2 \cdot 10^{1}$
Sheep	$1.75 \cdot 10^{9}$	$6 \cdot 10^{1}$
Chickens	$2.4 \cdot 10^{10}$	$2 \cdot 10^{0}$
Antarctic Krill	$7.8 \cdot 10^{14}$	$4.86 \cdot 10^{-4}$
Bacteria	$5 \cdot 10^{30}$	$1 \cdot 10^{-12}$

Which is larger: the total mass of all humans or of all the antarctic krill?

Humans:

$\left(7.5 \cdot 10^{9}\right)\left(6.2 \cdot 10^{1}\right) \approx 45 \cdot 10^{10}$ **kg**

Antarctic krill:

$\left(7.8 \cdot 10^{14}\right)\left(4.86 \cdot 10^{-4}\right) \approx 40 \cdot 10^{10}$ **kg**

The total mass of all humans is larger.

How can you tell which creature has the greatest total mass?

Responses vary. **Bacteria has the greatest total mass because multiplying the number of bacteria by the mass of one bacteria will give me** 10^{18}**, which is larger than any of the other products.**

About how many more chickens are there than sheep?

Responses vary. $2.4 \cdot 10^{10} - 1.75 \cdot 10^{9}$ **can be rewritten as** $2.4 \cdot 10 \cdot 10^{9} - 1.75 \cdot 10^{9}$ **or** $24 \cdot 10^{9} - 1.75 \cdot 10^{9}$**.**

There are $22.25 \cdot 10^{9}$ **more chickens than sheep, which is about about** 22 **billion.**

Summary Question

What are some important things to remember about adding, subtracting, multiplying, and dividing numbers written in scientific notation?

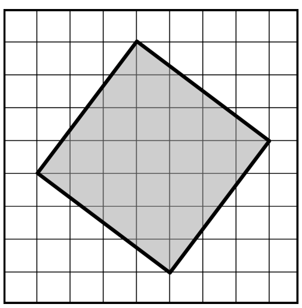
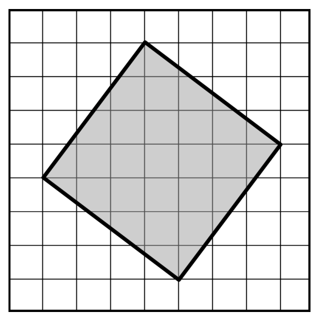
Responses vary. **When adding or subtracting numbers written in scientific notation, you have to have the same exponent for the powers of** 10**. When multiplying or dividing, you can multiply or divide the first factors, and then multiply or divide the powers of** 10**.**

Science Mom Lesson 113

Unit 8.8, Lesson 1: Notes Name ____________________________________

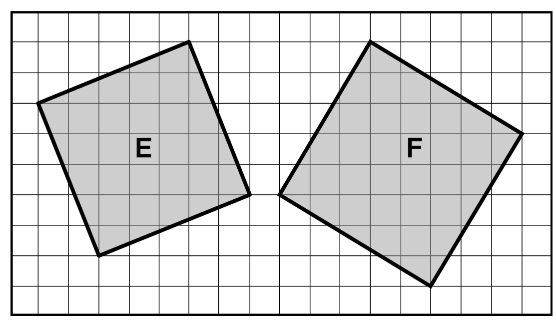
Learning Goal(s):

Sometimes we want to find the area of a square, but we don't know the side length. When this is true, we can use strategies such as "decompose and rearrange" and "surround and subtract."

Decompose and Rearrange	**Surround and Subtract**
	

Use any strategy to calculate the area of each square.

Square E Square F



Which of these squares must have a side length that is greater than 5 but less than 6? ________
Explain how you know.

Summary Question

If you don't know the side length of a square, how can you find its area?

desmos

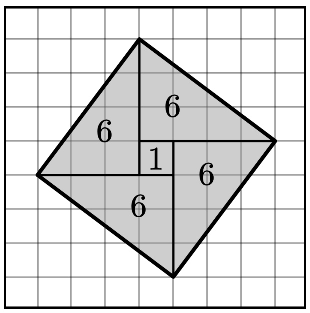
Unit 8.8, Lesson 1: Notes Name ____________________

Learning Goal(s):

- **I can calculate the area of a triangle.**
- **I can calculate the area of a tilted square on a grid by using methods like "decompose and rearrange" and "surround and subtract."**

Sometimes we want to find the area of a square, but we don't know the side length. When this is true, we can use strategies such as "decompose and rearrange" and "surround and subtract."

Decompose and Rearrange

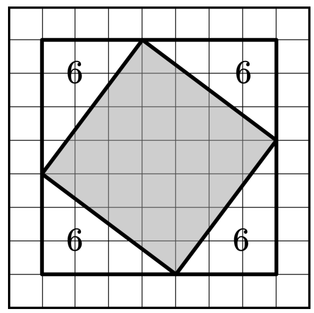


Area =

4 **triangles +** 1 **square**

$4 \cdot 6 + 1 = 25$ **square units**

Surround and Subtract



Area =

square - 4 **triangles**

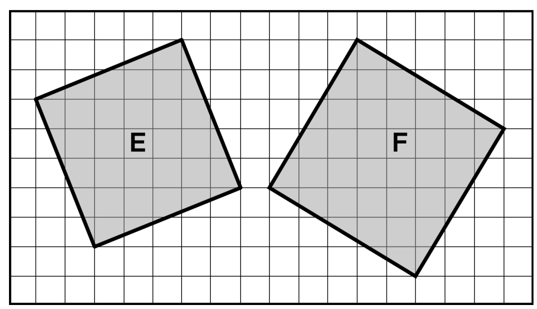
$7 \cdot 7 - 4 \cdot 6 = 25$

square units

Use any strategy to calculate the area of each square.

Square E: 29 **square units**

Square F: 34 **square units**



Which of these squares must have a side length that is greater than 5 but less than 6? **Both**

Explain how you know.

A square with a side length of 5 **has an area of** 25 **square units, and a square with a side length of** 6 **has an area of** 36 **square units. Squares E and F both have areas between** 25 **and** 36 **square units, so they both have side lengths greater than** 5 **and less than** 6**.**

Summary Question

If you don't know the side length of a square, how can you find its area?

I can enclose the square in a larger square whose area I do know. Then I can subtract out the areas of the four triangles that are between the larger square and the original square. This gives me the area of the original square.

Unit 8.8, Lesson 2: Notes Name ______________________________

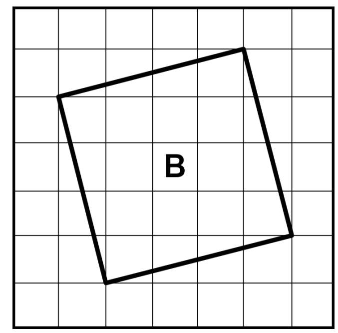
Learning Goal(s):

Sometimes we want to know the side length of a square whose length is not countable using a grid. When this is true, we can take the square root of the area in order to find the side length.

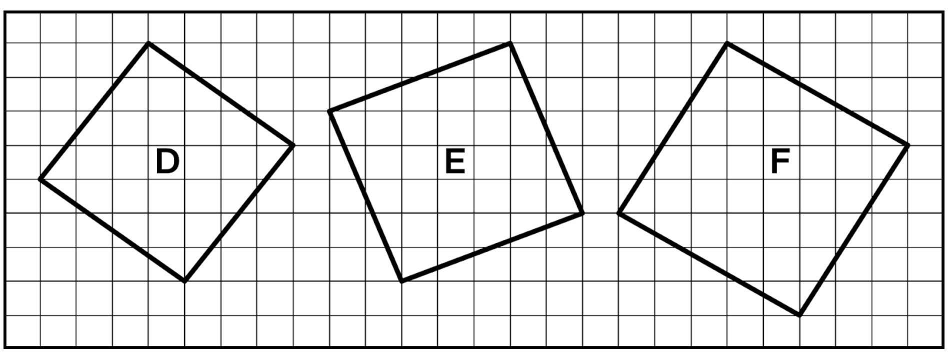
Square B has an area of 17.

We say the side length of a square with an area of 17 units is $\sqrt{17}$ units.

This means that $(\quad)^2 =$ ______.



Find each missing value.



Square	Side Length of Square (units)	Area of Square (square units)
D		25
E	$\sqrt{29}$	
F		

Summary Question

Explain the meaning of $(\sqrt{9})^2 = 9$ using squares and side lengths.

desmos

Unit 8.8, Lesson 2: Notes Name ____________________

Learning Goal(s):

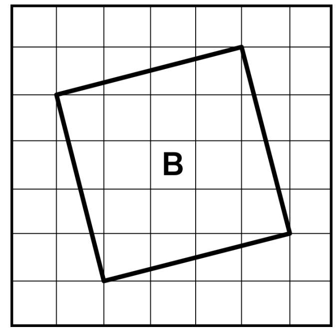
- **I can explain the meaning of square roots in terms of side length and area of a square.**
- **I can write the side length or the area of a square using square root notation (like $\sqrt{3}$).**

Sometimes we want to know the side length of a square whose length is not countable using a grid. When this is true, we can take the square root of the area in order to find the side length.

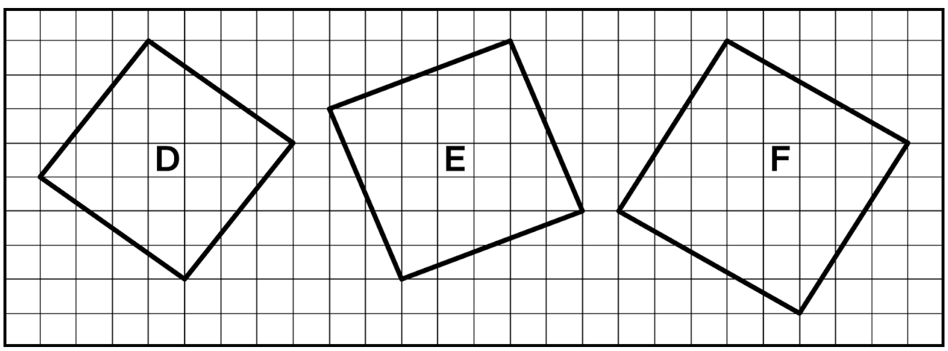
Square B has an area of 17.

We say the side length of a square with an area of 17 units is $\sqrt{17}$ units.

This means that $\left(\sqrt{17}\right)^2 = 17$.



Find each missing value.



Square	Side Length of Square (units)	Area of Square (square units)
D	$\sqrt{25}$	25
E	$\sqrt{29}$	29
F	$\sqrt{34}$	34

Summary Question

Explain the meaning of $\left(\sqrt{9}\right)^2 = 9$ using squares and side lengths.

A square with an area of 9 square units has a side length of $\sqrt{9}$ or 3. This makes sense because $3 \cdot 3 = 9$.

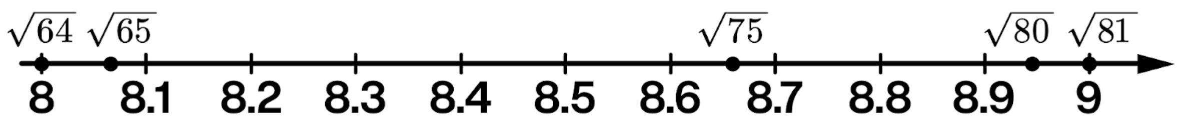
desmos **Science Mom Lesson 115**

Unit 8.8, Lesson 4: Notes Name ____________________________________

Learning Goal(s):

We can approximate the values of square roots by looking for whole numbers nearby.

- $\sqrt{65}$ is a little more than _____ , because $\sqrt{65}$ is a little more than $\sqrt{64}$ = ______.
- $\sqrt{80}$ is a little less than ______ , because $\sqrt{80}$ is a little less than $\sqrt{81}$ = ______.
- $\sqrt{75}$ is between ______ and ______ , because 75 is between 64 and 81 .
- $\sqrt{75}$ is approximately ______. We can check this by calculating _______________.

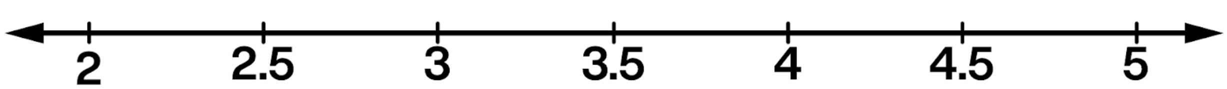


Under each description, write the square root(s) that lie between the integers described.

- $\sqrt{6}$
- $\sqrt{12}$
- $\sqrt{24}$
- x when $x^2 = 8$

Between 2 and 3	**Between 4 and 5**

Add each number above to the number line below.



Summary Question

Where would $\sqrt{17}$ belong on the number line above? Explain how you know.

desmos

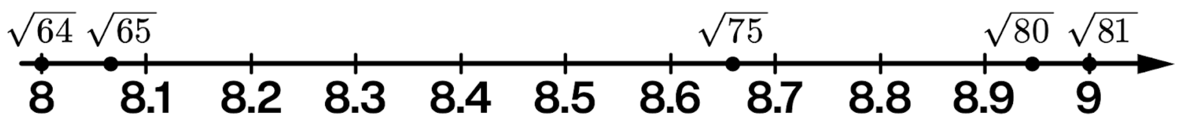
Unit 8.8, Lesson 4: Notes Name ____________________

Learning Goal(s):

- **I can plot square roots on a number line.**
- **I can identify the two whole numbers a square root is between and explain why.**

We can approximate the values of square roots by looking for whole numbers nearby.

- $\sqrt{65}$ is a little more than 8, because $\sqrt{65}$ is a little more than $\sqrt{64} = 8$.
- $\sqrt{80}$ is a little less than 9, because $\sqrt{80}$ is a little less than $\sqrt{81} = 9$.
- $\sqrt{75}$ is between 8 and 9, because 75 is between 64 and 81.
- $\sqrt{75}$ is approximately 8.67. We can check this by calculating $8.67^2 = 75.1689$**, which is close to** 75.

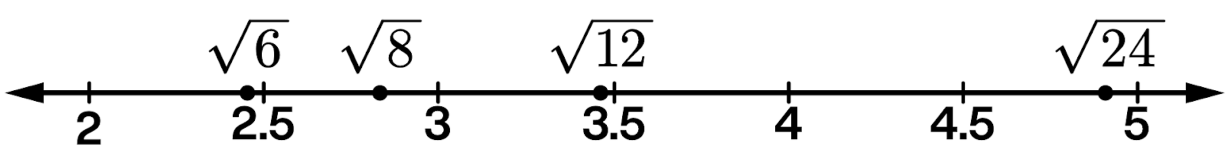


Under each description, write the square root(s) that lie between the integers described.

- $\sqrt{6}$
- $\sqrt{12}$
- $\sqrt{24}$
- x when $x^2 = 8$

Between 2 **and** 3	**Between** 4 **and** 5
$\sqrt{6}$ x **when** $x^2 = 8$	$\sqrt{24}$

Add each number above to the number line below.



Summary Question

Where would $\sqrt{17}$ belong on the number line above? Explain how you know.

$\sqrt{17}$ **is between** 4 **and** 5 **because** $\sqrt{17}$ **is larger than** $\sqrt{16} = 4$ **and smaller than** $\sqrt{25} = 5$. **It is much closer to** 4 **because** $\sqrt{17}$ **is much closer to** $\sqrt{16}$ **than it is to** $\sqrt{25}$.

Unit 8.8, Lesson 5: Notes Name ______________________________

Learning Goal(s):

Sometimes we are interested in the edge length of a cube instead of the side length of a square.

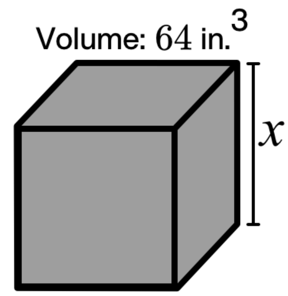
The number $\sqrt[3]{17}$, read as "cube root of 17," is the edge length of a cube that has a volume of 17.

We can approximate the value of a cube root in a similar way to approximating a square root:

$\sqrt[3]{17}$ is more than ______ , because $\sqrt[3]{17}$ is more than $\sqrt[3]{8}=$ ______ .

$\sqrt[3]{17}$ is less than ______ , because $\sqrt[3]{17}$ is less than $\sqrt[3]{27}=$ ______ .

$\sqrt[3]{17}$ is approximately _______ , because $(2.57)^3 = 16.9746$.



Find each missing value without using a calculator.

Exact Edge Length of Cube (units)	Approximate Edge Length of Cube (units)	Volume of Cube (cubic units)
	Between _____ and _____	60
$\sqrt[3]{4}$	Between _____ and _____	
	Between _____ and _____	25

Summary Question

Approximate the value of x when $x^3 = 81$. Explain your thinking.

Unit 8.8, Lesson 5: Notes Name ___________________________

Learning Goal(s):

- **I can explain the meaning of a cube root, like $\sqrt[3]{35}$, in terms of its edge length and volume.**
- **I can identify the two whole numbers a cube root is between and explain why.**

Sometimes we are interested in the edge length of a cube instead of the side length of a square.

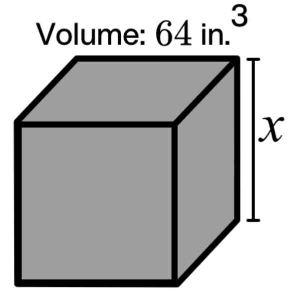
The number $\sqrt[3]{17}$, read as " cube root of 17," is the edge length of a cube that has a volume of 17.

We can approximate the value of a cube root in a similar way to approximating a square root:

$\sqrt[3]{17}$ is more than 2, because $\sqrt[3]{17}$ is more than $\sqrt[3]{8} = 2$.

$\sqrt[3]{17}$ is less than 3, because $\sqrt[3]{17}$ is less than $\sqrt[3]{27} = 3$.

$\sqrt[3]{17}$ is approximately 2.57, because $(2.57)^3 = 16.9746$.



Find each missing value without using a calculator.

Exact Edge Length of Cube (units)	**Approximate Edge Length of Cube (units)**	**Volume of Cube (cubic units)**
$\sqrt[3]{60}$	Between 3 and 4	60
$\sqrt[3]{4}$	Between 1 and 2	4
$\sqrt[3]{25}$	Between 2 and 3	25

Summary Question

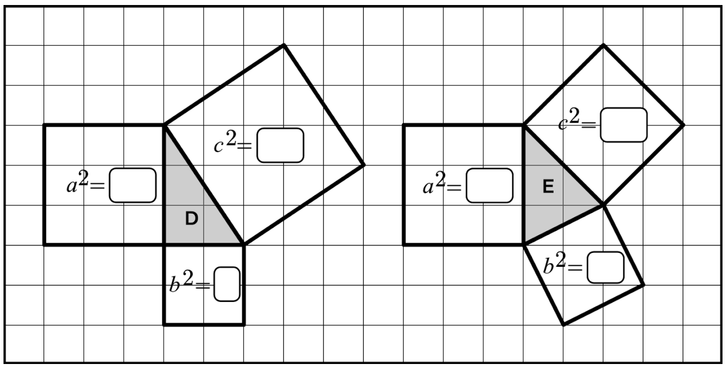
Approximate the value of x when $x^3 = 81$. Explain your thinking.

x **is equal to** $\sqrt[3]{81}$**, which is between** 4 **and** 5**. We know this is true because** $\sqrt[3]{64} = 4$**, and** $\sqrt[3]{125} = 5$**. In particular,** $x \approx 4.327$ **since** $4.327^3 = 81.014$**.**

Unit 8.8, Lesson 6: Notes Name ______________________________

Learning Goal(s):

Find the missing values. Record what you notice and wonder.



I notice . . .

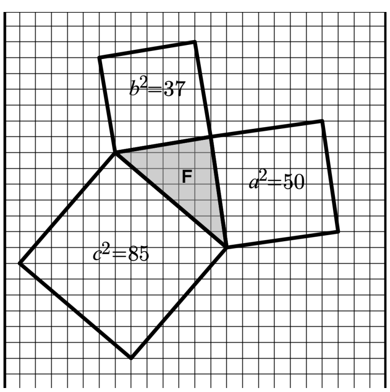
I wonder . . .

In Triangle D, the square of the hypotenuse is equal to the sum of the squares of the legs.

This relationship is true for **all** right triangles. It is often known as the **Pythagorean theorem.**

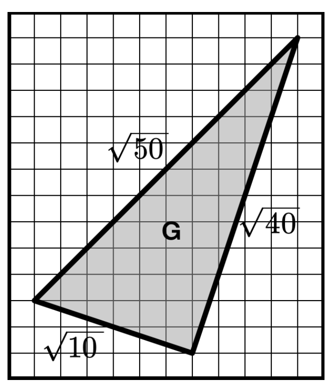
Another way to describe this relationship is $a^2 + b^2 = c^2$, where a and b are the lengths of the legs and c is the length of the hypotenuse of a right triangle.

Decide if the Pythagorean theorem is true for each triangle. Show your thinking.



Yes / No

Your thinking:



Yes / No

Your thinking:

Summary Question

What does the Pythagorean theorem tell us about the side lengths of a right triangle?

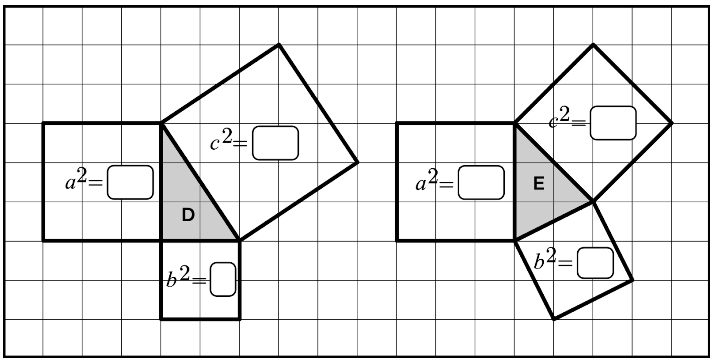
desmos

Unit 8.8, Lesson 6: Notes Name ______________________________

Learning Goal(s):

- **I can explain what the Pythagorean theorem says.**

Find the missing values. Record what you notice and wonder.



I noticed . . .
Responses vary.
I noticed that a^2 is equal in both diagrams.

I noticed the two small squares equaled the large square for Triangle D.

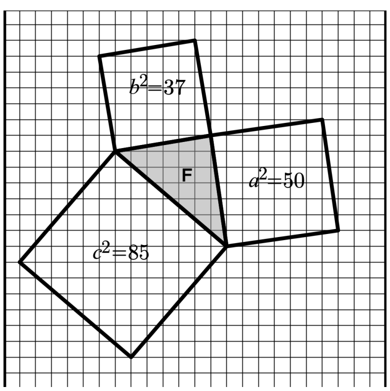
I wonder . . .
Responses vary.
How are the sides of the triangles related?

In Triangle D, the square of the hypotenuse is equal to the sum of the squares of the legs.

This relationship is true for **all** right triangles. It is often known as the **Pythagorean theorem.**

Another way to describe this relationship is $a^2 + b^2 = c^2$, where a and b are the lengths of the legs and c is the length of the hypotenuse of a right triangle.

Decide if the Pythagorean theorem is true for each triangle. Show your thinking.



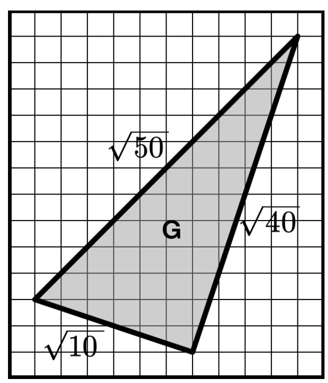
Yes / **No**

Your thinking:

Responses vary.

$37 + 50 \neq 85$ **so**

$a^2 + b^2 \neq c^2$



Yes / No

Your thinking:

Responses vary.

$(\sqrt{10})^2 + (\sqrt{40})^2$
$= 10 + 40$
$= 50$
$= (\sqrt{50})^2$

Summary Question

What does the Pythagorean theorem tell us about the side lengths of a right triangle?

Responses vary. **The Pythagorean theorem tells us that the sum of the squares of the shorter side lengths is equal to the square of the longest side length (the hypotenuse).**

desmos Science Mom Lesson 118

Unit 8.8, Lesson 7: Notes Name ____________________

Learning Goal(s):

We observed that $a^2 + b^2 = c^2$ is true for many right triangles with legs of a and b. How do we know this relationship is **always** true? Proofs help us know when a relationship will always be true.

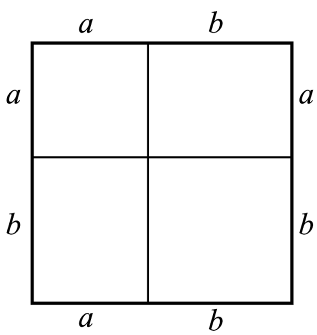


Figure G

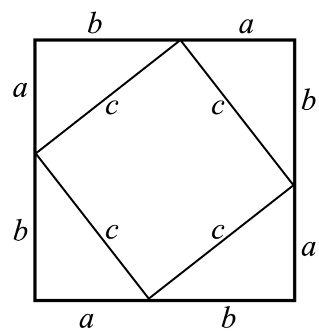


Figure H

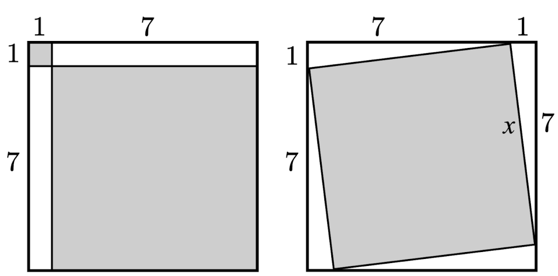
Habib wrote the following proof of the Pythagorean theorem based on the diagram:

$$a^2 + b^2 + ab + ab = c^2 + 4 \cdot \frac{1}{2}\ ab$$

$$a^2 + b^2 + 2ab = c^2 + 2ab$$

$$a^2 + b^2 = c^2$$

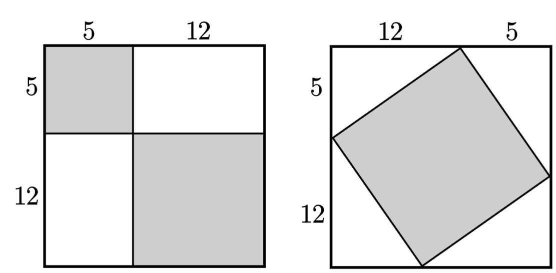
Describe Habib's strategy for proving the Pythagorean theorem. Use the diagrams if that helps to support your thinking.



Find the value of x.

Summary Question

Show how you can see the equation $5^2 + 12^2 = 13^2$ in the figures on the right. Explain how this relates to the Pythagorean theorem.



desmos

Unit 8.8, Lesson 7: Notes Name ______________________________

Learning Goal(s):
- **I can explain why the Pythagorean theorem is true for every right triangle.**
- **I can use the Pythagorean theorem to find unknown side lengths in right triangles.**

We observed that $a^2 + b^2 = c^2$ is true for many right triangles with legs of a and b. How do we know this relationship is **always** true? Proofs help us know when a relationship will always be true.

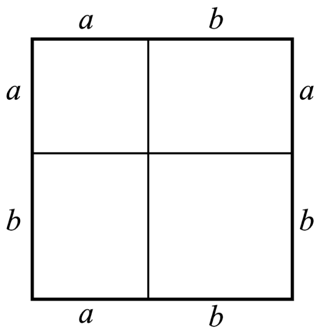


Figure G

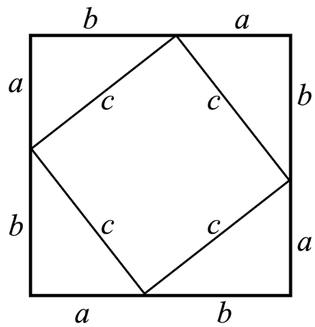


Figure H

Habib wrote the following proof of the Pythagorean theorem based on the diagram:

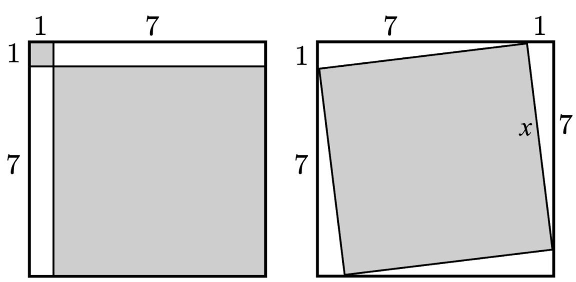
$$a^2 + b^2 + ab + ab = c^2 + 4 \cdot \frac{1}{2} ab$$

$$a^2 + b^2 + 2ab = c^2 + 2ab$$

$$a^2 + b^2 = c^2$$

Describe Habib's strategy to prove the Pythagorean theorem. Use the diagrams if that helps to support your thinking.

Habib found the total area for Figure G and for Figure H by adding up the areas of the individual parts. Since figures G and H have the same total area, Habib set the areas equal. Then, they simplified and subtracted $2ab$ from each side to get $a^2 + b^2 = c^2$.



Find the value of x.

$$7^2 + 1^2 = x^2$$

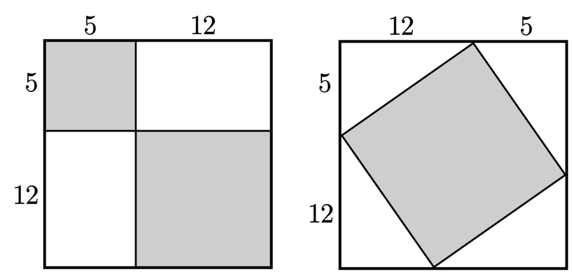
$$49 + 1 = x^2$$

$$50 = x^2$$

$$x = \sqrt{50}$$

Summary Question

Show how you can see the equation $5^2 + 12^2 = 13^2$ in the figures on the right. Explain how this relates to the Pythagorean theorem.



In the left figure, I see $5^2 + 12^2$ as the total area of the two shaded squares. The Pythagorean theorem says that the area of the shaded square in the right figure will be equal to the sum of the shaded squares in the left figure, so its area is 169 square units, or 13^2 square units.

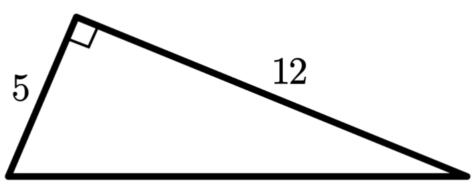
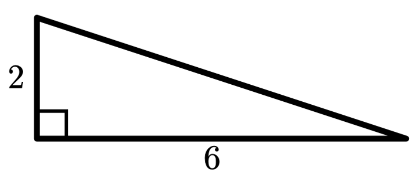
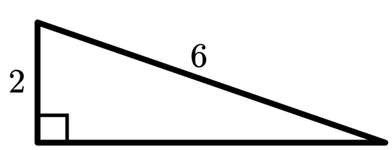
desmos Science Mom Lesson 119

Unit 8.8, Lesson 8: Notes Name ____________________________________

Learning Goal(s):

Sometimes we know the length of two sides of a right triangle and want to find the third. In this situation, we can use the Pythagorean theorem.

Highlight the hypotenuse of each triangle. Then find the length of the missing side of the triangle.

Triangle	Missing Side Length
	
	
	

Summary Question

How can you use the Pythagorean theorem to find an unknown side length in a right triangle?

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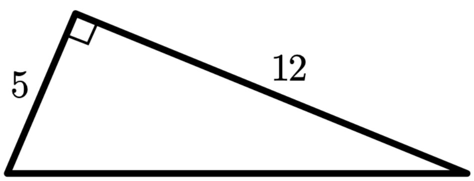
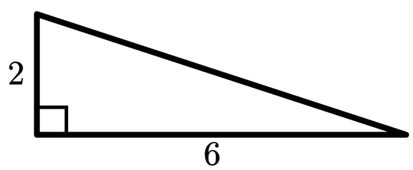
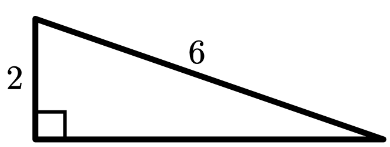
Unit 8.8, Lesson 8: Notes Name ______________________________

Learning Goal(s):
- **I can identify which side is the hypotenuse and which sides are the legs in a right triangle.**
- **I can use the Pythagorean theorem to find unknown side lengths in right triangles.**

Sometimes we know the length of two sides of a right triangle and want to find the third. In this situation, we can use the Pythagorean theorem.

Highlight the hypotenuse of each triangle. Then find the length of the missing side of the triangle.

Triangle	Missing Side Length
	$5^2 + 12^2 = c^2$ $25 + 144 = c^2$ $169 = c^2$ $c = 13$
	$2^2 + 6^2 = c^2$ $4 + 36 = c^2$ $40 = c^2$ $c = \sqrt{40}$
	$2^2 + b^2 = 6^2$ $4 + b^2 = 36$ $b^2 = 32$ $b = \sqrt{32}$

Summary Question
How can you use the Pythagorean theorem to find an unknown side length in a right triangle?

You can enter the side lengths you know into the equation and solve for the missing length. Remember that you will need to take a square root at some point!

Unit 8.8, Lesson 9: Notes Name ____________________________________

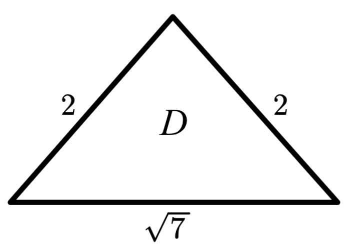
Learning Goal(s):

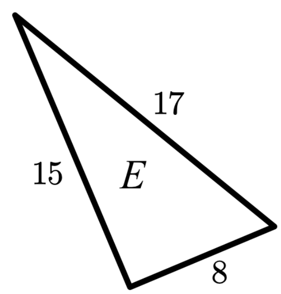
Sometimes it's hard to tell if a triangle is a right triangle just by looking. In this situation, we can use what is called the converse of the Pythagorean theorem to help us decide.

If ____ , the triangle is a right triangle.

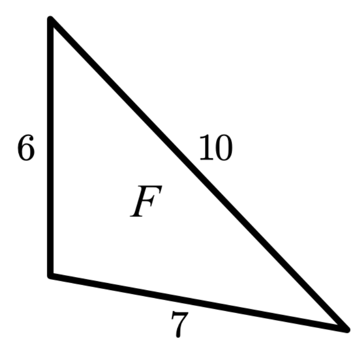
If ____, the triangle is not a right triangle.

Use the converse of the Pythagorean theorem to decide which of the following are right triangles.





Change **one** of the values to make triangle F into a right triangle.



Summary Question

Explain how to tell if a triangle is a right triangle using its side lengths.

Unit 8.8, Lesson 9: Notes Name ______________________________

Learning Goal(s):

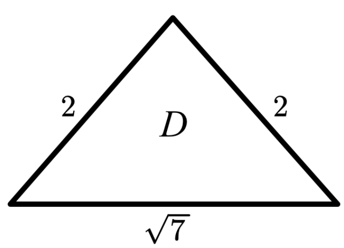
- **I can explain why it is true that if the side lengths of a triangle satisfy the equation $a^2 + b^2 = c^2$, then it must be a right triangle.**
- **I can determine whether a triangle is a right triangle if I know its side lengths.**

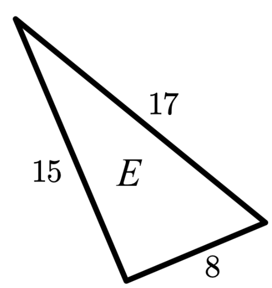
Sometimes it's hard to tell if a triangle is a right triangle just by looking. In this situation, we can use what is called the converse of the Pythagorean theorem to help us decide.

If $a^2 + b^2 = c^2$, the triangle is a right triangle.

If $a^2 + b^2 \neq c^2$, the triangle is not a right triangle.

Use the converse of the Pythagorean theorem to decide which of the following are right triangles.





$2^2 + 2^2 \neq (\sqrt{7})^2$, **so** D **is not a right triangle.**

$8^2 + 15^2 = 17^2$, **so** E **is a right triangle.**

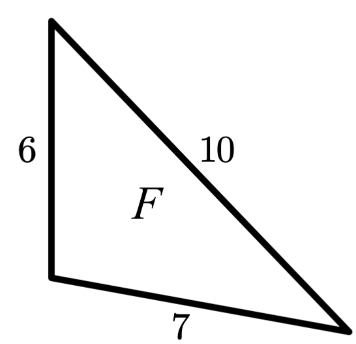
Change **one** of the values to make Triangle F into a right triangle.

Responses vary.

Change 7 **to** 8**, then** $6^2 + 8^2 = 10^2$ **and** F **is a right triangle.**

Change 6 **to** $\sqrt{51}$**, then** $(\sqrt{51})^2 + 7^2 = 10^2$ **.**

Change 10 **to** $\sqrt{85}$**, then** $6^2 + 7^2 = (\sqrt{85})^2$**.**



Summary Question

Explain how to tell if a triangle is a right triangle using its side lengths.

Responses vary.

Square each of the shorter side lengths and add them together. If that is the same as the hypotenuse squared, then the triangle is a right triangle.

Unit 8.8, Lesson 10: Notes Name ___________________________

Learning Goal(s):

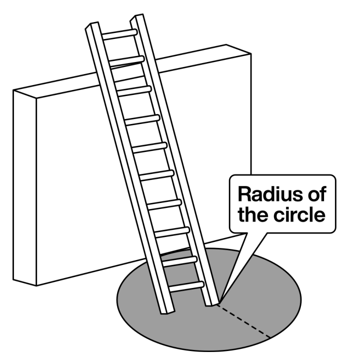
Name some situations in your world that might involve right triangles.

A 17-foot ladder is leaning against a wall. The ladder can reach a window 15 feet up the wall. How far from the wall should the base of the ladder be so that it reaches the window?

Draw a picture of the situation.

Write your answer to the question. Show all of your thinking.

To avoid accidents, the fire department wants to create a circular no-walk zone under the ladder with a radius that is the distance between the ladder and the wall. What is the area of the no-walk zone?



Summary Question

What are some things that are important to remember when using the Pythagorean theorem?

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Unit 8.8, Lesson 10: Notes Name ____________________________________

Learning Goal(s):

- **I can use the Pythagorean theorem to solve problems.**

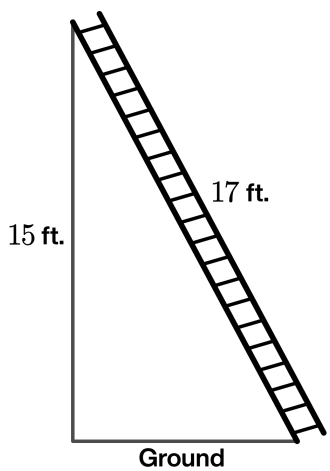
Name some situations in your world that might involve right triangles.

Responses vary.

- **Shadows**
- **Roofs**
- **Staircases & other architecture**
- **Bridges & electricity towers**
- **Sails on ships**
- **U.K. flag (the Union Jack)**

A 17-foot ladder is leaning against a wall. The ladder can reach a window 15 feet up the wall. How far from the wall should the base of the ladder be so that it reaches the window?

Draw a picture of the situation.



Write your answer to the question.
Show all of your thinking.

Let d represent the distance from the wall to the ladder.

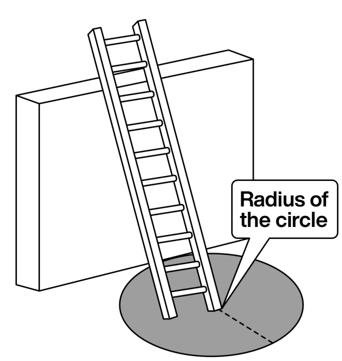
$$d^2 + 15^2 = 17^2$$
$$d^2 + 225 = 289$$
$$d^2 = 64$$

In this situation, d must be 8.
Place the ladder 8 feet from the wall.

To avoid accidents, the fire department wants to create a circular no-walk zone under the ladder with a radius that is the distance between the ladder and the wall. What is the area of the no-walk zone?

Area of a circle $= \pi \cdot r^2$

Area of no-walk zone $= \pi \cdot (8)^2 = 64\pi \approx 201$ **square feet**



Summary Question

What are some things that are important to remember when using the Pythagorean theorem?

***Responses vary.* You need to use the squares of the side lengths rather than the lengths themselves. Remember which lengths are the legs (vs. the hypotenuse) of the right triangle.**

desmos Science Mom Lesson 122

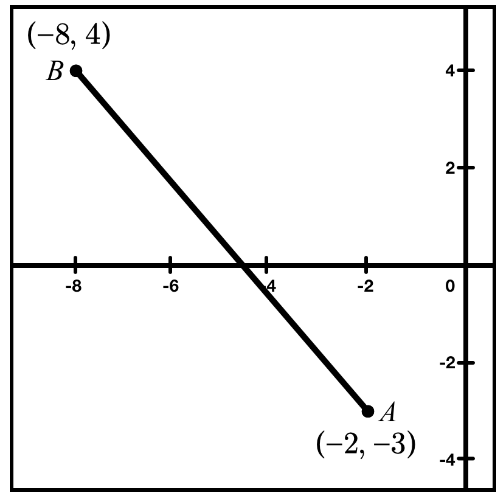
Unit 8.8, Lesson 11: Notes Name ____________________

Learning Goal(s):

Sometimes we want to find the distance between two points that are not easily countable on a grid.

Draw a right triangle whose hypotenuse is $\overline{AB}$.

Use the tools you have to calculate the length of $\overline{AB}$.

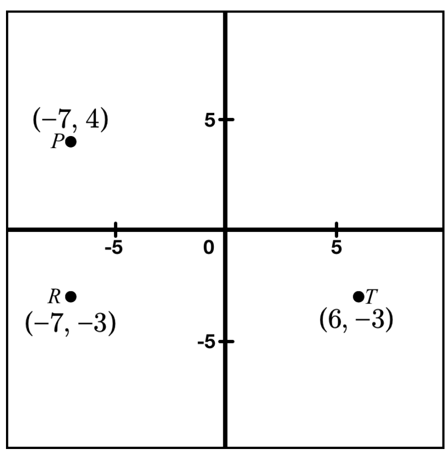


Calculate the distances between each pair of points on the graph.

$\overline{PR}$ = ______ units

$\overline{RT}$ = ______ units

$\overline{PT}$ = ______ units



Ready for more?

Plot a point that is exactly $\sqrt{29}$ units away from point R.

Summary Question

How is using the Pythagorean theorem on a grid similar to or different from using it on a triangle?

desmos

Unit 8.8, Lesson 11: Notes Name ____________________

Learning Goal(s):
- **I can calculate the distance between two points in the coordinate plane.**
- **I can calculate the length of a diagonal line segment in the coordinate plane.**

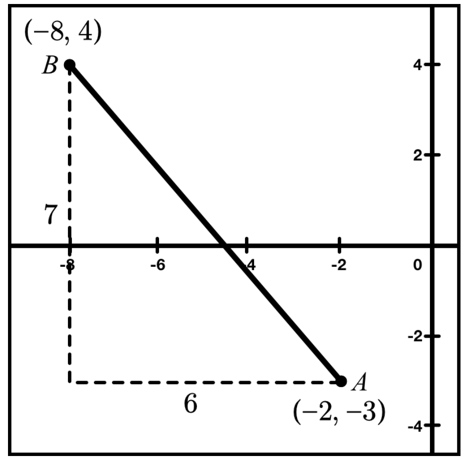
Sometimes we want to find the distance between two points that are not easily countable on a grid.

Draw a right triangle whose hypotenuse is $\overline{AB}$.

Use the tools you have to calculate the length of $\overline{AB}$.

$$\overline{AB} = \sqrt{6^2 + 7^2} = \sqrt{36 + 49} = \sqrt{85}$$

$\overline{AB}$ is $\sqrt{85}$ units long.

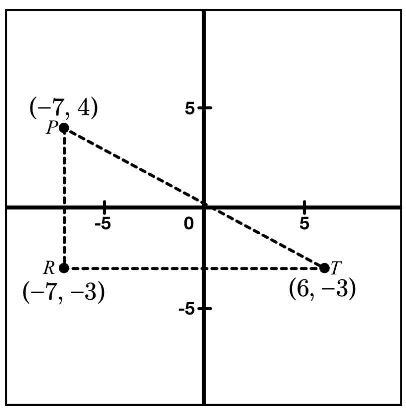


Calculate the distances between each pair of points on the graph.

$\overline{PR}$ = 7 units

$\overline{RT}$ = 13 units

$\overline{PT}$ =
$\sqrt{7^2 + 13^2} = \sqrt{49 + 169} = \sqrt{218}$
units



Ready for more?

Plot a point that is exactly $\sqrt{29}$ units away from point R.

Responses vary.
One correct response is $(-5, 2)$ because the distance between the x-coordinates of $(-5, 2)$ and $R = (-7, -3)$ is 2 and the distance between the y-coordinates is 5.
$\sqrt{5^2 + 2^2} = \sqrt{29}$.

Summary Question
How is using the Pythagorean theorem on a grid similar to or different from using it on a triangle?

On a grid and on a triangle, you use the same equation to find the missing sides. On a grid, the distance is often not given, and you need to figure it out using the coordinates you know.

Unit 8.8, Lesson 12: Notes Name ____________________________________

Learning Goal(s):

Sometimes it's helpful to rewrite fractions as decimals. Can you think of times this might be true?

Decimals can either terminate (stop) or continue infinitely. When the decimal repeats indefinitely, we draw a line over the repeating digits.

Expand $0.56\overline{73}$ = ____________________________________…

Describe how Kwame calculated that $\frac{2}{11} = .\overline{18}$ in your own words.

$$
\begin{array}{r}
0.1818... \\
11\overline{)\ 2.00000} \\
-11 \\
\hline
90 \\
-88 \\
\hline
20 \\
-11 \\
\hline
90 \\
-88 \\
\hline
20
\end{array}
$$

Use any strategy to write each fraction as a decimal. Decide whether it is terminating or repeating.

$\frac{3}{8}$	$\frac{3}{11}$	$\frac{98}{6}$
Terminating or repeating?	Terminating or repeating?	Terminating or repeating?

Summary Question

What are some clues you can use to predict if a fraction will be a terminating or a repeating decimal?

desmos

Unit 8.8, Lesson 12: Notes Name ____________________

Learning Goal(s):

- **I can write a fraction as either a repeating or a terminating decimal.**

Sometimes it's helpful to rewrite fractions as decimals. Can you think of times this might be true?

Decimals can either terminate (stop) or continue infinitely. When the decimal repeats indefinitely, we draw a line over the repeating digits.

Expand $0.56\overline{73} = 0.5673737373737373737373737373...$

Describe how Kwame calculated that $\frac{2}{11} = .\overline{18}$ in your own words.

Kwame divided 2 by 11 in order to find the decimal. He used long division and added trailing zeros when needed.

$$
\begin{array}{r}
0.1818... \\
11 \overline{)\ 2.00000} \\
-11 \\ \hline
90 \\
-88 \\ \hline
20 \\
-11 \\ \hline
90 \\
-88 \\ \hline
20
\end{array}
$$

Use any strategy to write each fraction as a decimal. Decide whether it is terminating or repeating.

$\frac{3}{8} = 0.375$

$$
\begin{array}{r}
0.375 \\
8 \overline{)\ 3.000} \\
-24 \\ \hline
60 \\
-56 \\ \hline
40 \\
-40 \\ \hline
0
\end{array}
$$

Terminating or repeating?

$\frac{3}{11} = 0.\overline{27}$

$$
\begin{array}{r}
0.2727... \\
11 \overline{)\ 3.00000} \\
-22 \\ \hline
80 \\
-77 \\ \hline
30 \\
-22 \\ \hline
80 \\
-77 \\ \hline
30
\end{array}
$$

Terminating or **repeating**?

$\frac{98}{6} = 16.\overline{3}$

$$
\begin{array}{r}
16.333... \\
6 \overline{)\ 98.00} \\
6 \\ \hline
38 \\
-36 \\ \hline
20 \\
-18 \\ \hline
20 \\
-18 \\ \hline
20
\end{array}
$$

Terminating or **repeating**?

Summary Question

What are some clues you can use to predict if a fraction will be a terminating or a repeating decimal?

***Responses vary.* If the denominator of the fraction is a power of 2 (like 8), then the fraction terminates. If the denominator of the fraction is a multiple of 3 (like 6), then the fraction repeats.**

desmos **Science Mom Lesson 124**

Unit 8.8, Lesson 13: Notes Name ____________________

Learning Goal(s):

Some decimals terminate, while others repeat. However, **all** terminating and repeating decimals can be written as fractions. Look at the example below to see what we mean.

Describe each step of Adhira's process for converting $4.\overline{85}$ to $\frac{481}{99}$.

$x = 4.\overline{85}$

1. $100x = 485.\overline{85}$
2. $-x = -4.\overline{85}$
3. $99x = 481$
4. $x = \frac{481}{99}$

Use any strategy to write each decimal as a fraction.

$5.\overline{37}$	$5.\overline{3}$	$0.3\overline{7}$

Summary Question

What question(s) do you have about converting repeating decimals into fractions? (You can also record a question you imagine someone else having about this topic.)

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Unit 8.8, Lesson 13: Notes Name ____________________

Learning Goal(s):

- **I can write a repeating decimal as a fraction.**
- **I understand that every number has a decimal expansion.**

Some decimals terminate, while others repeat. However, **all** terminating and repeating decimals can be written as fractions. Look at the example below to see what we mean.

Describe each step of Adhira's process for converting $4.\overline{85}$ to $\frac{481}{99}$.

$x = 4.\overline{85}$

1. **Multiply both sides by 100. This keeps the decimal part of the number the same as it was.** $100x = 485.\overline{85}$
2. **Multiply x by -1. The decimal part of $100x$ and $-x$ are equal.** $-x = -4.\overline{85}$
3. **Combine $-x$ and $100x$. This is now equal to a whole number.** $99x = 481$
4. **Divide both sides by 99. This is the value of $1x$.** $x = \frac{481}{99}$

Use any strategy to write each decimal as a fraction.

$5.\overline{37}$	$5.\overline{3}$	$0.3\overline{7}$
$100x = 537.\overline{37}$	$10x = 53.\overline{3}$	$100x = 37.\overline{7}$
$-x = -5.\overline{37}$	$-x = -5.\overline{3}$	$-10x = -3.\overline{7}$
$99x = 532$	$9x = 48$	$90x = 34$
$x = \frac{532}{99}$ **(or equivalent)**	$x = \frac{48}{9}$ **(or equivalent)**	$x = \frac{34}{90}$ **(or equivalent)**

Summary Question

What question(s) do you have about converting repeating decimals into fractions? (You can also record a question you imagine someone else having about this topic.)

Responses vary.

- **How do you decide what to multiply by x?**
- **Why do you multiply x by a negative number in Step 2?**

Unit 8.8, Lesson 14: Notes Name ___________________________________

Learning Goal(s):

Rational numbers are numbers that can be written as a fraction of two integers. What if a number cannot be written as a fraction of two integers? We call this type of number an irrational number.

Definition	Facts/Characteristics
Irrational Number	
Examples	Non-Examples

Write each number as a rational number. If it is impossible, write “irrational.”

0.16	$\frac{\sqrt{16}}{\sqrt{100}}$	$\sqrt{8}$	x when $x^3 = 64$	$\sqrt[3]{16}$

Summary Question

What does it mean when someone says that $\sqrt{3}$ is irrational?

Unit 8.8, Lesson 14: Notes Name ______________________________

Learning Goal(s):

- **I know what a rational number is and can give an example.**
- **I know what an irrational number is and can give an example.**

Rational numbers are numbers that can be written as a fraction of two integers. What if a number cannot be written as a fraction of two integers? We call this type of number an irrational number.

Irrational Number

Definition	Facts/Characteristics
A number that cannot be written as a fraction of two integers.	**Their decimal representations are neither terminating nor repeating.**
Examples	**Non-Examples**
$\sqrt{7}$ π $5(\sqrt[3]{15})$	$\sqrt{9}$ $\frac{3}{4}$ -5.34 $-5.\overline{34}$

Write each number as a rational number. If this is impossible, write "irrational."

0.16	$\frac{\sqrt{16}}{\sqrt{100}}$	$\sqrt{8}$	x when $x^3 = 64$	$\sqrt[3]{16}$
$\frac{16}{100}$ **(or equivalent)**	$\frac{4}{10}$ **(or equivalent)**	**Irrational**	4	**Irrational**

Summary Question

What does it mean when someone says that $\sqrt{3}$ is irrational?

This means that $\sqrt{3}$ cannot be written as a fraction of whole numbers or as a repeating or terminating decimal.