

8th Grade Mathematics

Unit 2 Curriculum Map: October 28th – January 3rd



ORANGE PUBLIC SCHOOLS
OFFICE OF CURRICULUM AND INSTRUCTION
OFFICE OF MATHEMATICS

Common Core Standards

GRADE 8 CONTENT	
8.F.1	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
8.EE.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
8.EE.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. <i>For example, estimate the population of the United States as 3 times 10^8 and the population of the world as 7 times 10^9, and determine that the world population is more than 20 times larger.</i>
8.EE.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology
8.SP.1	Construct and interpret scatterplots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
8.SP.2	Know that straight lines are widely used to model relationships between two quantitative variables. For scatterplots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
8.SP.4	Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. <i>For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?</i>

Model Curriculum Student Learning Objectives

SLO	Description	Calculator Allowed (PARCC)
1 8.F.1	Define linear functions as a rule that assigns one output to each input and determine if data represented as a graph or in a table is a function.	NO
2 8.EE.1	Apply the properties of integer exponents to simplify and write equivalent numerical expressions.	NO
3 8.EE.3	Use scientific notation to estimate and express the values of very large or very small numbers and compare their values (how many times larger/smaller is one than the other).	NO
4 8.EE.4	Perform operations using numbers expressed in scientific notation, including problems where both decimals and scientific notation are used (interpret scientific notation generated when technology has been used for calculations).	NO
5 8.SP.1 8.SP.2	Construct and interpret scatter plots for bivariate measurement data and identify and interpret data patterns (clustering, outliers, positive or negative association, possible lines of best fit, and nonlinear association).	NO
6 8.EE.4	In real-world problem solving situations choose units of appropriate size for measurement of very small and very large quantities.	YES
7 8.SP.4	Construct frequency/relative frequency tables to analyze and describe possible associations between two variables.	YES

Connections to the Mathematical Practices

1	Make sense of problems and persevere in solving them
	- Students use tools, conversions, and properties to solve problems
2	Reason abstractly and quantitatively
	<ul style="list-style-type: none"> - Students use concrete numbers to explore the properties of numbers in exponential form and then prove that the properties are true for all positive bases and all integer exponents using symbolic representations for bases and exponents. - Use symbols to represent integer exponents and make sense of those quantities in problem situations. - Students refer to symbolic notation in order to contextualize the requirements and limitations of given statements (e.g., letting m, n represent positive integers, letting a, b represent all integers, both with respect to the properties of exponents)
3	Construct viable arguments and critique the reasoning of others
	<ul style="list-style-type: none"> - Students reason through the acceptability of definitions and proofs (e.g., the definitions of x^0 and x^{-b} for all integers b and positive integers x). - New definitions, as well as proofs, require students to analyze situations and break them into cases. - Examine the implications of definitions and proofs on existing properties of integer exponents. Students keep the goal of a logical argument in mind while attending to details that develop during the reasoning process.
4	Model with mathematics
	- When converting between measurements in scientific notations, students understand the scale value of a number in scientific notation in one unit compared to another unit
5	Use appropriate tools strategically
	<ul style="list-style-type: none"> - Understand the development of exponent properties yet use the properties with fluency - Use unit conversions in solving real world problems
6	Attend to precision
	- In exponential notation, students are required to attend to the definitions provided throughout the lessons and the limitations of symbolic statements, making sure to express what they mean clearly. Students are provided a hypothesis, such as $x < y$, for positive integers x , y , and then asked to evaluate whether a statement, like $-2 < 5$, contradicts this hypothesis.
7	Look for and make use of structure
	- Students understand and make analogies to the distributive law as they develop properties of exponents. Students will know $x^m \cdot x^n = x^{m+n}$ as an analog of $m^x + n^x = (m+n)^x$ and $(x^m)^n = x^{m \times n}$ as an analog of $n \times (m \times x) = (n \times m) \times x$.
8	Look for and express regularity in repeated reasoning
	<ul style="list-style-type: none"> - While evaluating the cases developed for the proofs of laws of exponents, students identify when a statement must be proved or if it has already been proven. - Students see the use of the laws of exponents in application problems and notice the patterns that are developed in problems.

Vocabulary

Term	Definition
<i>Additive Inverse</i>	Two numbers whose sum is 0 are additive inverses of one another. Example: $\frac{3}{4}$ and $-\frac{3}{4}$ are additive inverse of one another because $\frac{3}{4} + (-\frac{3}{4}) = (-\frac{3}{4}) + \frac{3}{4} = 0$
<i>Addition Property of Equality</i>	For real numbers a, b, and c, if $a = b$, then $a + c = b + c$. In other words, adding the same number to each side of an equation produces an equivalent equation.
<i>Algebraic Expression</i>	A mathematical phrase involving at least one variable. Expressions can contain numbers and operation symbols.
<i>Cube Root</i>	If the cube root of a number b is a (i.e., $\sqrt[3]{b} = a$), then $a^3 = b$.
<i>Decimal Expansion</i>	The decimal expansion of a number is its representation in base 10 (i.e., the decimal system). For example, the decimal expansion of 25^2 is 625, or π is 3.14159..., and of $1/9$ is 0.1111...
<i>Equation</i>	A mathematical sentence that contains an equals sign
<i>Exponent</i>	The number of times a base is used as a factor of repeated multiplication
<i>Evaluate an Algebraic Expression</i>	To perform operations to obtain a single number or value
<i>Inverse Operation</i>	Pairs of operations that undo each other, for example, addition and subtraction are inverse operations and multiplication and division are inverse operations.
<i>Like Terms</i>	Monomials that have the same variable raised to the same power. Only the coefficients of like terms can be different
<i>Multiplicative Inverses</i>	Two numbers whose product is 1 are multiplicative inverses of one another. Example: $\frac{3}{4}$ and $\frac{4}{3}$ are multiplicative inverses of one another because $\frac{3}{4} \times \frac{4}{3} = \frac{4}{3} \times \frac{3}{4} = 1$.
<i>Multiplication Property of Equality</i>	For real numbers a, b, and c ($c \neq 0$), if $a = b$, then $ac = bc$. In other words, multiplying both sides of an equation by the same number produces an equivalent expression.
<i>Perfect Square</i>	A number that has a rational number as its square root.
<i>Radical</i>	A symbol $\sqrt{\quad}$ that is used to indicate square roots
<i>Rational</i>	A number that can be written as the ratio of two integers with a nonzero denominator

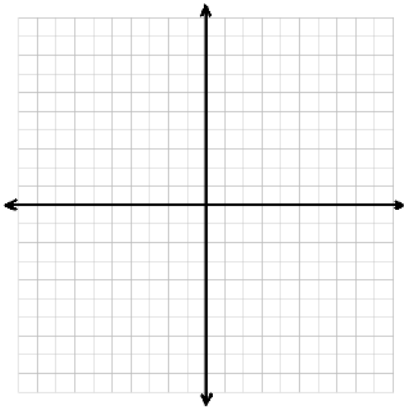

<i>Square Root</i>	One of two equal factors of a nonnegative number. For example, 5 is a square root of 25 because $5 \times 5 = 25$. Another square root of 25 is -5 because $(-5) \times (-5) = 25$. The +5 is called the principle square root of 25 and is always assumed when the radical symbol is used.
<i>Scientific Notation</i>	A representation of real numbers as the product of a number between 1 and 10 and a power of 10, used primarily for very large or very small numbers.
<i>Solution</i>	The value or values of a variable that make an equation a true statement.
<i>Solve</i>	Identify the value that when substituted for the variable makes the equation a true statement.
<i>Variable</i>	A letter or symbol used to represent a number
<i>Domain</i>	Domain of a relation is the set of all x-coordinates of the ordered pairs of that relation
<i>Function</i>	A rule of matching elements of two sets of numbers in which an input value from the first set has only one output value in the second set.
<i>Graph of a Function</i>	The set of all the points on a coordinate plane whose coordinates makes the rule of the function true.
<i>Range of a Function</i>	The set of all output values or the y-values of a function or a relation is called the range of the function or relation.
<i>Qualitative Variables</i>	A variable whose values are not numerical. Examples include gender (male, female), paint color (red, black, blue), etc.
<i>Bivariate Data</i>	Two different response variables that are from the same population.
<i>Quantitative Variables</i>	A variable whose values are numerical. Examples include height, temperature, weight, grades, and etc.
<i>Model</i>	A mathematical representation of a process, device, or concept by means of a number of variables.
<i>Interpret</i>	To establish or explain the meaning or significance of something.
<i>Linear</i>	A relationship or function that can be represented by a straight line.
<i>Non-Linear</i>	A relationship which does not create a straight line
<i>Slope</i>	The measure of steepness of a line
<i>Scatter Plot</i>	The graph of a collection of ordered pairs that allows an exploration of the relationship between the points.
<i>Line of Best Fit</i>	A straight line drawn through the center of a group of data points plotted on a

	scatter plot.
<i>Outlier</i>	An element of a data set that distinctly stands out from the rest of the data

Potential Student Misconceptions

- Students fail to recognize that a function's input is the x value, and the output is the y-value. Assign real world situations to input and output values to see the concept of the vertical line test. Example: If every runner in a marathon were given the same bib number, we wouldn't be able to distinguish between the runners. Some runners may have the same time, but we can distinguish between the two by their bib numbers.
- Students often mistake the exponent as the number of zeros to put on the end of the coefficient instead of realizing it represents the number of times they should multiply by ten.
- When multiplying or dividing numbers that are given in scientific notation, in which the directions say to write the answer in scientific notation, sometimes students forget to double check that the answer is in correct scientific notation.
- When performing calculations on a calculator, in which the number transforms to scientific notation, students sometimes overlook the last part of the number showing scientific notation part and just notice the first part of the number, ignoring the number after E.
- Students will sometimes multiply the base and the exponent. For example, 2^6 is not equal to 12, it's 64.
- When writing numbers in scientific notation, students may interpret the negative exponent as a negative number.
- Students think the line of best fit must go through (0,0). This is sometimes true, but students need to be able to understand what the y-intercept means in the situation and determine if it makes sense given the situation.
- When trying to decide if there is a correlation of data, students will sometimes have confusion about whether there is positive, negative, or no correlation.

Teaching Multiple Representations

CONCRETE REPRESENTATIONS																					
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<ul style="list-style-type: none"> Graphing Calculator 																					
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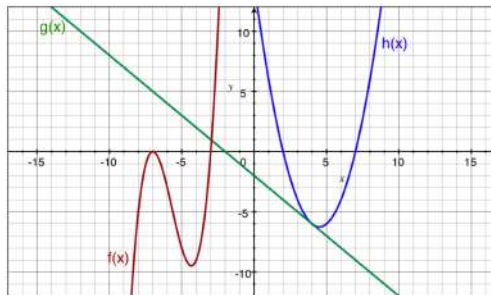
- **Making sense of exponents**

$$\frac{(2u^2v^3)^4}{2u^4v^4 \cdot 2uv} = \frac{16u^8v^{12}}{4u^5v^5} = 4u^3v^3$$

$$2 \cdot 2 \cdot 2 \cdot 2 = 16$$

$$\frac{1m^3n^4 \cdot 2m^3n^4}{(2m^4n^3)^4} = \frac{2m^6n^8}{16m^{16}n^{12}} = \frac{1}{8m^{10}n^4}$$

- **Graphs of functions**



- **Two-Way Frequency Table**

	Ritual A	Ritual B	Totals
Male	43	9	52
Female	44	4	48
TOTALS	87	13	100

ABSTRACT REPRESENTATIONS

- Equations
- Scientific Notation
- Integer powers of 10
- Properties of integer exponents

Pacing Guide

Activity	Common Core Standards/SLO	Estimated Time
CMP2 Common Core Investigation 1: Exponents	8.EE.1 SLO: 2	2 days
<i>Illustrative Math Task: Extending the Definition of Exponents</i>	8.EE.1 SLO: 2	1 day
Growing, Growing, Growing Investigation 1 ACE 39-40	8.EE.3 SLO: 3	1 days
Growing, Growing, Growing Investigation 2 ACE 15-17	8.EE.3 SLO: 3	1 day
Growing, Growing, Growing Investigation 4 ACE 8	8.EE.3 SLO: 3	1 day
<i>Illustrative Math Task: Ants vs. Elephants</i>	8.EE.3 SLO: 3	1 day
Growing, Growing, Growing Investigation 5	8.EE.1, 8.EE.3, 8.EE.4 SLO: 1, 3, 4, 6	3 days
Growing, Growing, Growing Investigation 5 ACE 56-60	8.EE.1, 8.EE.3, 8.EE.4 SLO: 1, 3, 4, 6	2 days
<i>Illustrative Math Task: Giantburger</i>	8.EE.4 SLO: 4, 6	1 day
Assessment Check 1	8.EE.1, 8.EE.3, 8.EE.4 SLO: 1, 3, 4, 6	1 day
CMP2 Common Core Investigation 2: Functions	8.F.1 SLO: 1	3 days
<i>Illustrative Math Task: Foxes and Rabbits</i>	8.F.1 SLO: 1	1 day
Samples and Populations Investigation 4	8.SP.1, 8.SP.2 SLO: 5	2 days
<i>Illustrative Math Task: Birds Egg's</i>	8.SP.1, 8.SP.2 SLO: 5	1 day
CMP2 Common Core Investigation 5: Bivariate Data	8.SP.4 SLO: 7	2 days
<i>Illustrative Math Task: Favorite Subject</i>	8.SP.4 SLO: 7	1 day
Assessment Check 2	8.F.1, 8.SP.1, 8.SP.2, 8.SP.4 SLO: 1, 5, 7	1 day
Selected Review	Based on Assessment Checks	3 days
Unit Assessment	All Standards and SLOs	Week of 12/16

Illustrative Math Tasks

Extending the Definition of Exponents (8.EE.1)

Marco and Seth are lab partners studying bacterial growth. They were surprised to find that the population of the bacteria doubled every hour.

- a) The table shows that there were 2,000 bacteria at the beginning of the experiment. What was the size of population of bacteria after 1 hour? After 2, 3 and 4 hours? Enter this information into the table:

Hours into study				0	1	2	3	4
Population (thousands)				2				

- b) If you know the size of the population at a certain time, how do you find the population one hour later?
- c) Marco said he thought that they could use the equation $P = 2t + 2$ to find the population at time t . Seth said he thought that they could use the equation $P = 2 \cdot 2^t$. Decide whether either of these equations produces the correct populations for $t = 1, 2, 3, 4$.
- d) Assuming the population doubled every hour before the study began, what was the population of the bacteria 1 hour before the students started their study? What about 3 hours before?
- e) If you know the size of the population at a certain time, how do you find the population one hour earlier?
- f) What number would you use to represent the time 1 hour before the study started? 2 hours before? 3 hours before? Finish filling in the table if you haven't already.
- g) Now use Seth's equation to find the population of the bacteria 1 hour before the study started. Use the equation to find the population of the bacteria 3 hours before. Do these values produce results consistent with the arithmetic you did earlier?
- h) Use the context to explain why it makes sense that $2^{-n} = \left(\frac{1}{2}\right)^n = \frac{1}{2^n}$. That is, describe why, based on the population growth, it makes sense to define 2 raised to a negative integer exponent as repeated multiplication by $\left(\frac{1}{2}\right)$.

Ant vs. Elephant (8.EE.3)

An ant has a mass of approximately 4×10^{-3} grams and an elephant has a mass of approximately 8 metric tons.

- How many ants does it take to have the same mass as an elephant?
- An ant is 10^{-1} cm long. If you put all these ants from your answer to part (a) in a line (front to back), how long would the line be?

Note: 1 kg = 1000 grams, 1 metric ton = 1000 kg, 1m = 100 cm, 1km = 1000m

Giantburger (8.EE.4)

This headline appeared in a newspaper:

EVERY DAY 7% OF AMERICANS EAT AT GIANTBURGER RESTAURANTS

Decide whether this headline is true using the following information:

- There are about 8×10^3 Giantburger restaurants in America.
- Each restaurant serves on average 2.5×10^3 people every day
- There are about 3×10^8 Americans.

Explain your reasons and show clearly how you came to this conclusion.

Foxes and Rabbits (8.F.1)

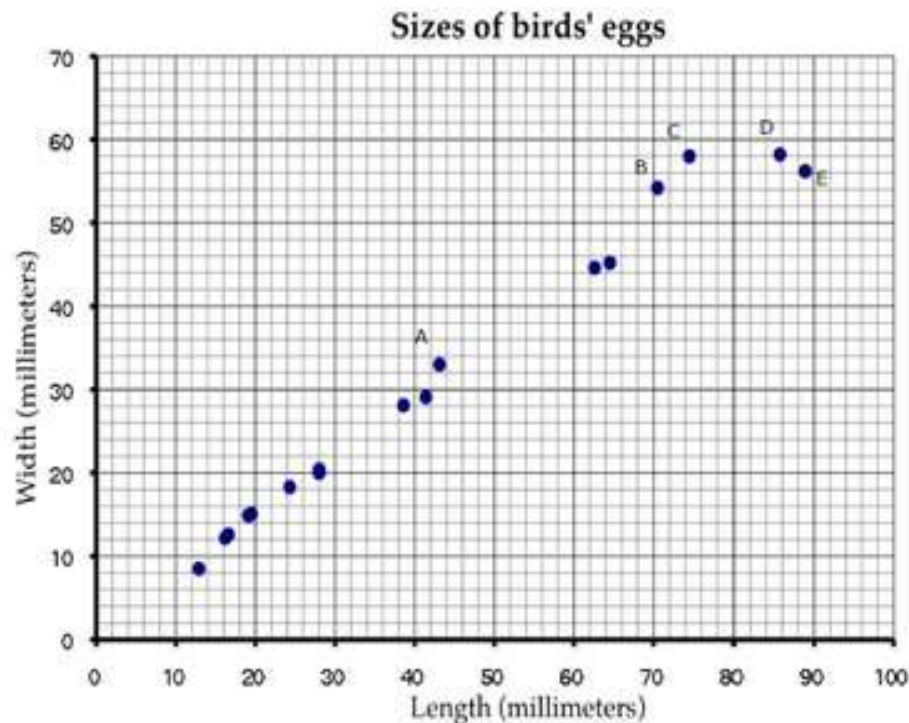
Given below is a table that gives the populations of foxes and rabbits in a national park over a 12 month period. Note that each value of t corresponds to the beginning of the month.

t , month	1	2	3	4	5	6	7	8	9	10	11	12
R , number of rabbits	1000	750	567	500	567	750	1000	1250	1433	1500	1433	1250
F , number of foxes	150	143	125	100	75	57	50	57	75	100	125	143

- According to the data in the table, is F a function of R ? Is R a function of F ? Explain.
- Are either R or F functions of t ? Explain.

Birds Eggs (8.SP.1, 8.SP.2)

This scatter plot shows the lengths and widths of the eggs of some American birds.



- A biologist measured a sample of one hundred Mallard duck eggs and found they had an average length of 57.8 millimeters and average width of 41.6 millimeters. Use an X to mark a point that represents this on the scatter diagram.
- What does the graph show about the relationship between the lengths of birds' eggs and their widths?
- Another sample of eggs from similar birds has an average length of 35 millimeters. If these bird eggs follow the trend in the scatter plot, about what width would you expect these eggs to have, on average?
- Describe the differences in shape of the two eggs corresponding to the data points marked C and D in the plot.

What's your favorite subject? (8.SP.4)

All the students at a middle school were asked to identify their favorite academic subject and whether they were in 7th grade or 8th grade. Here are the results:

Favorite Subject by Grade					
Grade	English	History	Math/Science	Other	Totals
7th Grade	38	36	28	14	116
8th Grade	47	45	72	18	182
Totals	85	81	100	32	298

Is there an association between favorite academic subject and grade for students at this school? Support your answer by calculating appropriate relative frequencies using the given data.

Assessment Checks

Assessment Check 1

- 1) Which of the following is equivalent to $5^2 + 5^2$?

a) 10^2
b) 5^4
c) 20
d) 2×5^2

- 2) Fill in the blanks in the exponent boxes and lines below to complete the pattern of exponents and equivalent values.

$$10^5 = 100,000$$

$$10^4 = 10,000$$

$$10^3 = 1,000$$

$$10^{\square} = \underline{\hspace{2cm}}$$

$$10^{\square} = \underline{\hspace{2cm}}$$

$$10^{\square} = \underline{\hspace{2cm}}$$

$$10^{\square} = \underline{\hspace{2cm}}$$

- 3) Write a number on the line below that is equivalent to the expression

$$10^{-5} \times 10^2 = 10^{\square}$$

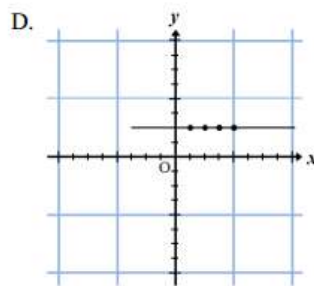
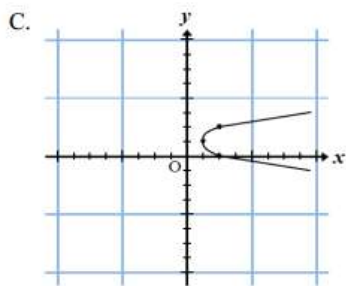
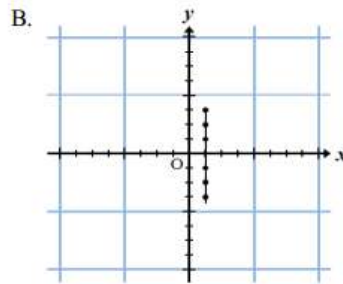
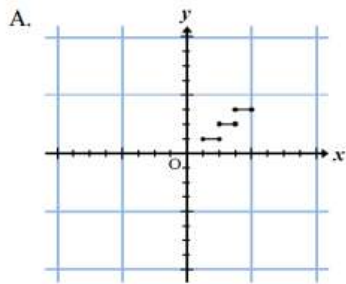
- 4) The average distance from Jupiter to the Sun is about 5×10^8 miles. The average distance from Venus to the Sun is about 7×10^7 miles.

The average distance from Jupiter to the Sun is about how many times as great as the average distance from Venus to the Sun? Show your work.

- 5) The population of Boston is approximately 75 times the population of Austin. There are 3.75×10^5 people living in Boston. Approximately how many people live in Austin?

Assessment Check 2

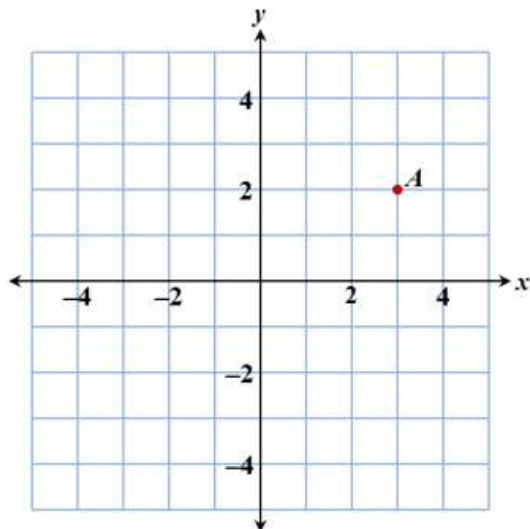
1) Which of the following could be the graph of a function?



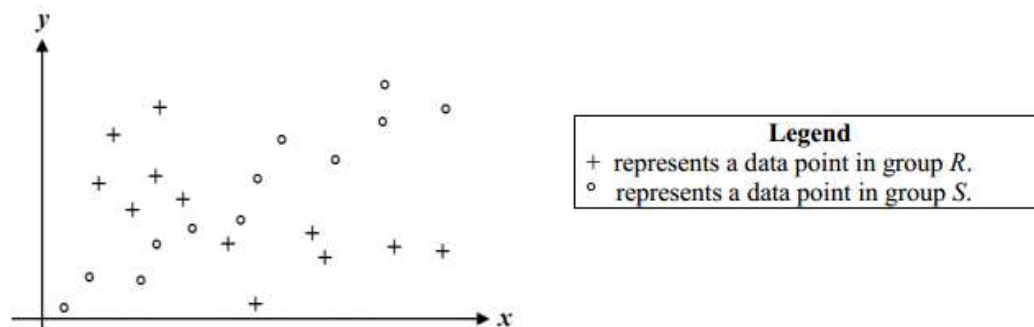
2) Point A is plotted on the xy-coordinate plane below. You must determine the location of point C given the following criteria:

- Point C has integer coordinates
- The graph of line AC is NOT a function.

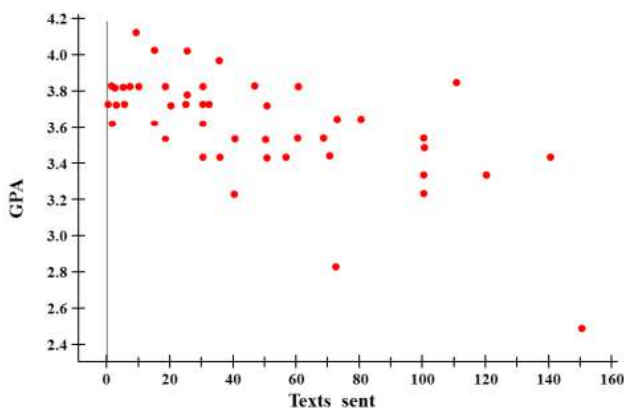
Plot on the xy-coordinate plane below to place a point that could represent point C.



3) The scatterplot below shows data for groups R and S. Which of the following statements about the correlation between the x and y values of group R and the correlation between the x and y values of group S?



- The x and y values appear to be negatively correlated in both R and S.
 - The x and y values appear to be positively correlated in both R and S.
 - The x and y values appear to be negatively correlated in R but positively correlated in S
 - The x and y values appear to be positively correlated in R but negatively correlated in S.
- 4) Megan suspects that there is a relationship between the number of text messages high school students send and their academic achievement. To explore this, she asks each student in a random sample of 52 students from her school how many text messages he or she sent yesterday and what his or her target grade point average (GPA) was during the most recent marking period. The data are summarized in the scatter plot of number of text messages sent versus GPA shown below.



Describe the relationship between number of text messages sent and GPA. Discuss both the overall pattern and any deviations from the pattern.

- 5) The table shows the game system that eighty 8th graders chose to be their favorite:

	XBox	Play Station	Wii	Total
Boys	21	14	5	40
Girls	6	14	20	40
Total	27	28	25	80

Of the eighty 8th graders surveyed, what percentage is girls who prefer Wii?

Extensions

Online Resources

<http://www.illustrativemathematics.org/standards/k8>

- Performance tasks, scoring guides

<http://www.ixl.com/math/grade-8>

- Interactive, visually appealing fluency practice site that is objective descriptive

<https://www.khanacademy.org/>

- Tracks student progress, video learning, interactive practice

http://www.doe.k12.de.us/assessment/files/Math_Grade_8.pdf

- Common Core aligned assessment questions, including Next Generation Assessment Prototypes

*Assessment Resources***Summative Tasks**Ants vs. Humans (8.EE.1, 8.EE.4)

The average mass of an adult human is about 65 kilograms while the average mass of an ant is approximately 4×10^{-3} grams. The total human population in the world is approximately 6.84 billion, and it is estimated there are currently about 10,000 trillion ants alive.

Based on these values, how does the total the total mass of all living ants compare to the total mass of all living humans?

Pennies to Space (8.EE.3, 8.EE.4, 8.F.1)

A penny is about $\frac{1}{16}$ of an inch thick.

- In 2011 there were approximately 5 billion pennies minted. If all of these pennies were placed in a single stack, how many miles high would that stack be?
- In the past 100 years, nearly 500 billion pennies have been minted. If all of these pennies were placed in a single stack, how many miles high would that stack be?
- The distance from the moon to the earth is about 239,000 miles. How many pennies would need to be stacked in order to reach the moon?

Animal Brains (8.SP.1, 8.SP.2)

Is there an association between the weight of an animal's body and the weight of the animal's brain?

- Make a scatterplot using the following data.

Animal	Body Weight (kg)	Brain Weight (g)
Mountain beaver	1.35	465
Cow	465	423
Grey wolf	36.33	119.5
Goat	27.66	115
Guinea pig	1.04	5.5
Asian elephant	2547	4603
Donkey	187.1	419
Horse	521	655
Potar monkey	10	115

Cat	3.3	25.6
Giraffe	529	680
Gorilla	207	406
Human	62	1320
African elephant	6654	5712
Rhesus monkey	6.8	179
Kangaroo	35	56
Golden hamster	0.12	1
Mouse	0.023	0.4
Rabbit	2.5	12.1
Sheep	55.5	175
Jaguar	100	157
Chimpanzee	52.16	440
Mole	0.122	3
Pig	192	180
Body and brain weight by animal.		

- b. Do there appear to be outliers in this data? Which animals appear to be outliers? Explain how you identified these outliers.
- c. Removing the outliers from the data set, make a new scatterplot of the remaining animal body and brain weights.
- d. Does there appear to be a relationship between body weight and brain weight? If yes, write a brief description of the relationship.
- e. Take a piece of uncooked spaghetti and use that spaghetti to informally fit a line to the data. Attempt to place your line so that the vertical distances from the points to the line are as small as possible.
- f. How well does the spaghetti line appear to fit the data? Explain.