News Literacy Model Curriculum in Math

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Table of Contents

A Note for Teachers

The lessons in this guide were developed by a team of veteran math teachers from across the country. They are designed to represent the multitude of ways in which news literacy concepts can be incorporated into math classrooms at all grade levels. Lessons are aligned to Common Core State Standards and are created to be flexible and to be used independently or in concert with other lessons. In addition to the content standards listed for each lesson, these lessons also meet the following Partnership for 21st Century Skills (P21) framework:

Skills	*P21 outcomes*
Critical Thinking	1. Reason effectively 2. Use systems thinking 3. Make judgments and decisions
Communication	1. Communicate clearly
Information Literacy	1. Access and evaluate information 2. Use and manage information
Media Literacy	1. Analyze media

Please note that because of copyright restrictions, some supplementary lesson materials appear as links to outside content. We encourage you to scale up or scale down each lesson as appropriate for your students.

News Literacy Framework

For each lesson, you'll find a recommended time frame, materials, and a detailed instruction plan that walks you step-by-step through the lesson. Most importantly, you'll find learning objectives that specify which content-based skills are addressed and which core news literacy question is used to guide the lesson.

Each lesson is aligned to one of the four guiding news literacy questions, established by the News Literacy Project:

1. Why does news matter?
2. Why is the First Amendment protection of free speech so vital to American democracy?
3. How can students know what to believe?
4. What challenges and opportunities do the Internet and digital media create?

These questions supply the framework through which students develop, practice, and apply their mathematical skills in a news literacy context. In doing so, we believe students will make more meaningful connections between this core educational subject area and the ever-changing media world in which they live.

News Literacy Model Curriculum in Math
Grades 7/8

Lesson 1: Buffalo Blizzard

Lesson 1

Buffalo Blizzard

Literacy in news spans all areas of life, including the weather. Tracking and thinking about the weather has serious implications for our lives. Students need to understand that changes in weather can have dramatic consequences on their daily lives. In this case, we take a look at the impact of the Lake Effect on Buffalo in November of 2014. Students will think about the impact of snow accumulation and think about how to represent the weather using graphs, tables, and equations. Furthermore, students will reference different articles and media sources to think about the historical patterns of weather.

Grade Level: 7-8
Required Time: 3-5 class days

Learning Objectives
Students will:

- Make sense of various weather tables and graphs in the news
- Compare and contrast interactive and static weather graphs
- Use various news sources to analyze weather trends
- Use their understanding of ratios and statistics to make sense of weather patterns
- Use their understanding of slope to talk about a trend in weather
- Interpret changes in a graph or table to think about a weather pattern

Guiding News Literacy Question: Why does news matter?
Weather reports are an integral part of most news publications, but sometimes the data and terminology used are confusing to the average reader. Understanding how weather is quantified and reported helps citizens make the best decisions regarding safety during inclement weather.

Common Core State Standards

CCSS.Math.6.SP.B4	Display numerical data in plots on a number line, including dot plots, histograms, and boxplots.
CCSS.Math.6.SP.B5	Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
CCSS.Math.6.RP.A3	Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape

	diagrams, double number line diagrams, or equations.
CCSS.Math.6.EE.B6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
CCSS.Math.7.SP.A1	Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
CCSS.Math.7.EE.A1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
CCSS.Math.7.EE.A2	Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*
CCSS.Math.7.RP.A2	Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
CCSS.Math.8.SP.A2	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots 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.
CCSS.Math.8.SP.A3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height*.
CCSS.Math.8.EE.B5	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
CCSS.Math.8.EE.C7	Solve linear equations in one variable.

Materials and Preparation
Buffalo Blizzard Slideshow/PowerPoint
Graph and scratch paper for all students
Snow Table Worksheet
Computers for research
Assessments

Note: Students and teachers should already have a foundation of graphing linear equations and using points to find the equation of a line. The teacher might also want to browse the resources and familiarize themselves with the Buffalo Snowstorm of November 2014.

Teachers will find illustrations and diagrams throughout the lesson that are also included in a PowerPoint presentation with this lesson.

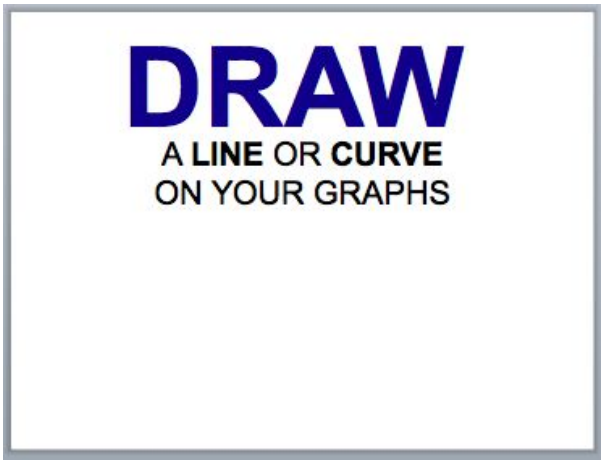
Instructional Plan

Introduction and Building Background

To start, open the Buffalo Blizzard Slideshow/PowerPoint that accompanies this lesson. Each image in this lesson is also its own slide.

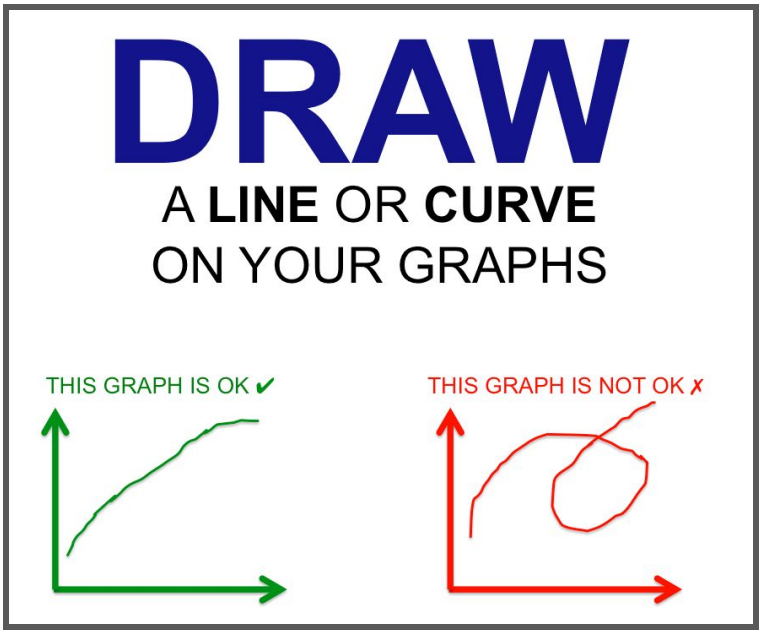
At the start this lesson, you are helping students create the problems they are solving. Each student will draw one line or curve on four different graphs. Eventually, each line and curve will represent a weather trend over time. Specifically, these lines will represent snow accumulation over time. Part of the fun here is that the students don't know anything about this context. All they know is that they are drawing a line or curve.

They start the process without knowing exactly what the line represents. Instead, we establish the simple guidelines. The first slide has the basic instructions:



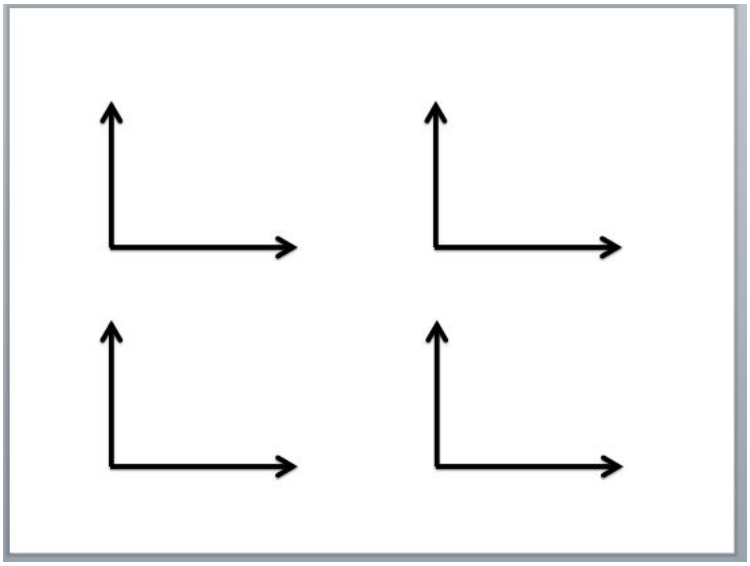
Tell students, "You are going to draw some curves and lines on a collection of graphs. I have a set of blank graphs for you to use. But before you draw your lines and curves, let me clarify a few rules."

Show the next slide with the two samples:



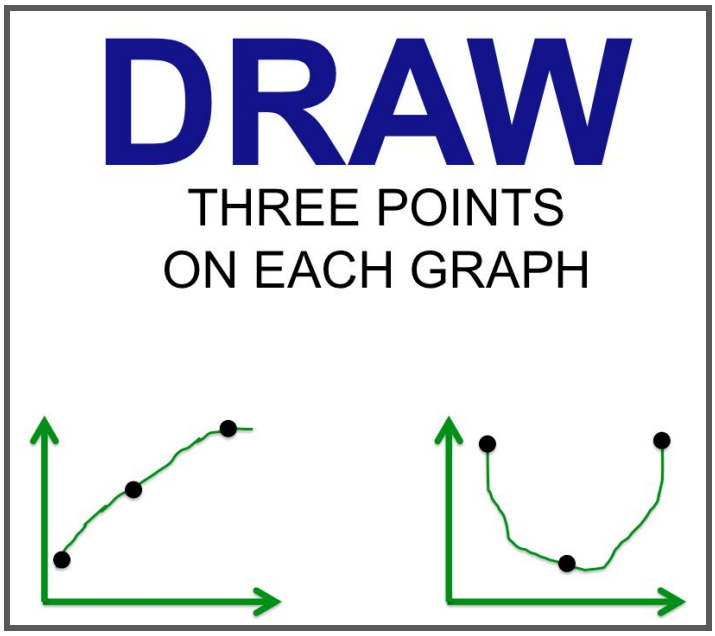
Here you are clarifying that the lines they draw can follow any trend. The only rule to follow is that no curve or line should cross over itself. To help students understand this rule, you could explain that the line needs to be a function and must pass the vertical line test. If you haven't covered those topics yet, you could use this opportunity to explain the meaning of a function and the meaning of the vertical line test. If you don't want to introduce those concepts, show them several examples to help them understand the types of lines and curves you are looking for. Of course, the vertical line test explains the rules of this exercise both quickly and efficiently.

Once you have explained the types of lines and curves that work and the types that don't, students will draw their graphs on the Four Blank Graphs Worksheet in the materials section.The Four Blank Graphs Worksheet looks like this:



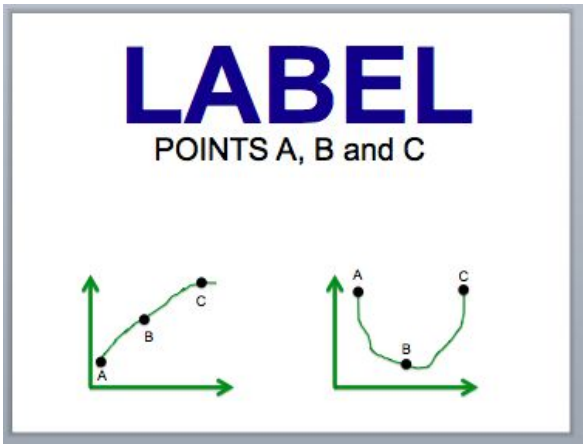
Students should take about a minute to draw their lines and curves on the “four blank graphs” template. Remember, these lines will represent snow accumulation over time, but students don’t know that. They only know that they are drawing four different lines or curves, one on each graph. Once the lines are drawn out, the next instruction is displayed.

Next, they draw three points on each line or curve. Again, they don’t know anything around the context. The next slide shows and example and gives another sample curve (a roughly drawn parabola):

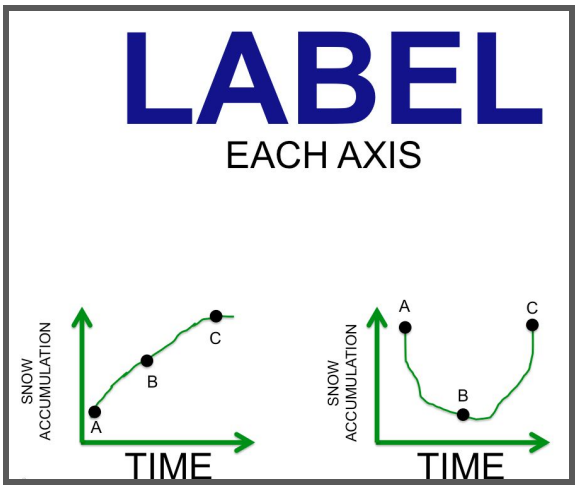


Likewise, the next slide builds in another layer, the labeling of the points. Here the points A, B, and C can be labeled in any order. However, the slide is set up to suggest that the points should go from left to right.

You might consider encouraging this to simplify the following “turn and talk” and class talk:

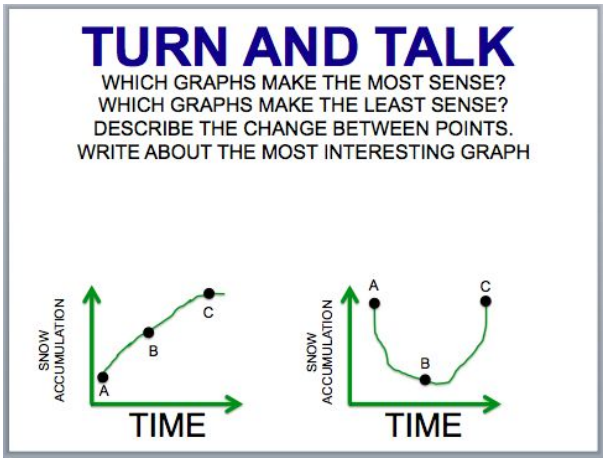


At this point, the students are still not aware of the meaning of these graphs. The following slide finally reveals the meaning of the graph through the labeling of each axis. You might want to pause a little between the fade in of each axis to build suspense:

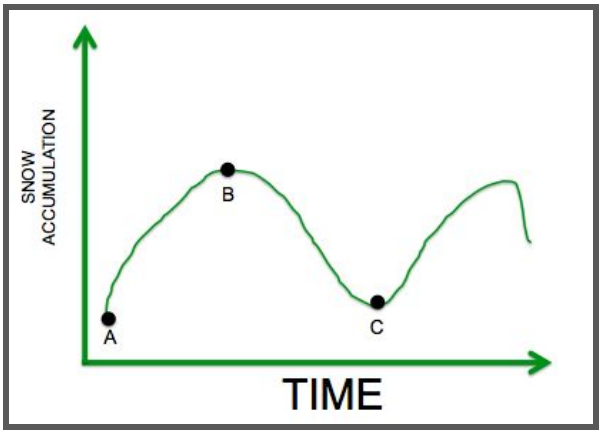


Turn and Talk

Here ask students to “turn and talk” with each other. The “turn and talk” is a simple teaching move in which you give students a minute or two to discuss their idea. Not only does this allow many partnerships to fix any errors in their thinking, it also boosts their confidence before sharing. The “turn and talk” that follows is meant to be a chance for students to uncover the weirdness that emerged from this process. They will have fun discussing the main turn and talk points: What made sense and what didn’t? Most importantly, can they describe the change that takes place between points.

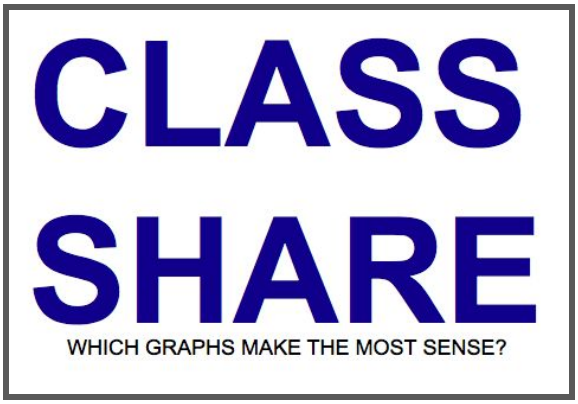


As students discuss their ideas, circulate and check in on their reasoning. Are they able to identify the “weird” graphs? For example, they might pinpoint something like this:

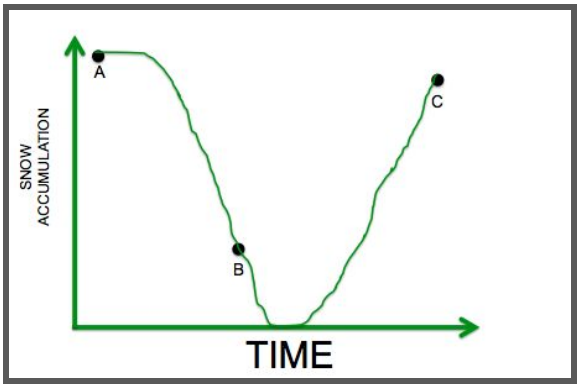


At first this might not seem weird, but what if the time span was all within one day or week? Imagine if the time span was one day. Students should be able to articulate that the snow accumulation builds up from A to B, melts down from B to C, and accumulates after that. This would be quite a bizarre scenario.

After students have had about five minutes to review their ideas, have them share their ideas and discoveries. Start with the “weird” scenarios, as they will serve as a hook for class discussion:



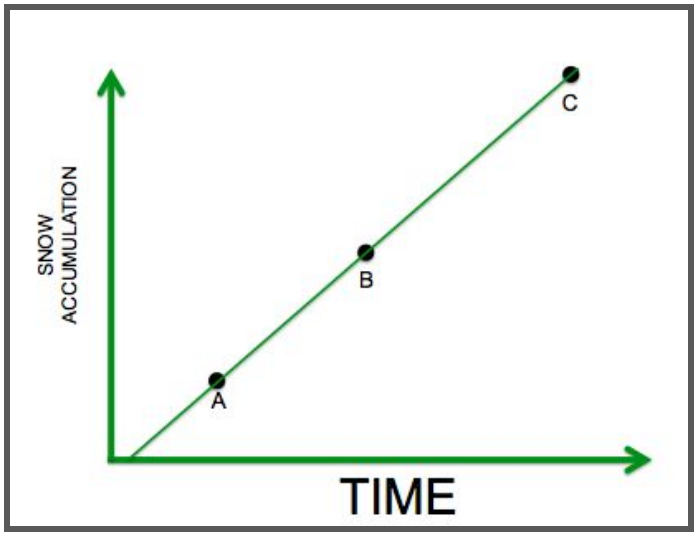
When students present their ideas, help them describe the “weird” features of their graph. For example, a student might present the graph below:



They might say something like, “This one was weird because the snow melted down to the ground and then built right back up.” Since that type of an explanation isn’t going to help the class understand their idea, ask clarifying questions:

> “Doesn’t snow melt and come back every year?”
>
> “What time ranges would this type of melt and accumulation be acceptable for?”
>
> “How would you describe the change from A to B?”
>
> “How can we tell where the snow is melting and where it is building back up?”
>
> “What does it mean when the graph hits the very bottom of its height?”
>
> “What would it mean if the graph’s height went below zero?”

Next, allow students to show graphs that seem reasonable. This might be far more difficult to do because the merits of a graph are easy to attack. For example, a student might show the graph below:



In many ways this graph is reasonable. Students might explain how this shows a steady increase in the snow level over time, almost like it is simply snowing all day and building up as it snows. Although this seems reasonable, it might be fun to describe some "unreasonable features" of the graph. Of course, make sure the student presenting is comfortable with such a discussion. Invite the class to critique the graph (not the person). In this case, you might say a few of the following:

> "It is unreasonable to assume that snow accumulates at an exactly steady rate."
>
> "If the time span is longer than a few days, it might be representing the world's longest blizzard."
>
> "If the line continues on without end, that implies that the snow level also increases without end."

Applying Expertise to Current Events

Once the class has had enough time to share their graphs, show them some of the weather breakdown of the November 2014 lake-effect snow storm. There are many sites listed in the resource section, but it might make sense to show the slide below and then show the snow accumulation graph provided:

The photo below could also serve for some other talking points on the snow storm:

http://www.weather.com/storms/winter/news/lake-effect-snow-significant-lake-erie-lake-ontario-20141115

On the link above, show students the photo of the map showing that in some regions the snow accumulated over 70 inches.

Ask students to share what they notice. It could be a low level observation about the color scheme or something more specific about the numbers and number ranges.

In this way you are integrating a basic feature of the media overlooked by many students: the weather. Not only do the media display current weather, but they help society process weather trends over time. There is so much weather data that many people need help deciphering what it all means. Reading about the weather in the news can give perspective on questions that are long term, “I wonder if the average temperature has been increasing each year?” and short term, “I wonder what I should wear to prepare for this upcoming winter storm?”

Many students might not watch or read much about the weather, but they need to be able to use the historical account of weather over time to think about the serious questions surrounding global warming and other major issues. In this case, they are using news literacy sources to think about the seriousness of the snowfall during the lake-effect storm in Buffalo.

Evaluating the guiding news literacy question: Why does news matter?
At this point in the lesson, ask students to stop and think about the biggest or most significant weather event that has happened to them recently. On a piece of paper, ask them to create a t-chart or two-column with the following headers:

The storm according to the news	The storm according to social media

Ask students to work in pairs or groups and research what sorts of things the news media reported about the storm (its size, impact, novelty factor, duration, intensity, etc). Then, they should research how social media reported the storm (they might need to go on Facebook or Twitter, or even a site like Reddit or Storify, to find this information). Fill out each column with their observations, and then ask the class to gather together to report on their findings.

Ask: Based on what you found, why does news information matter? Why is it helpful? How was it different or more reliable than what was on social media? (If anything, students should notice that news coverage was consistent and ongoing, which is important during a major weather event).

Graphing the storm
After talking about the conversions to feet, along with any other observations they made, let them know that they are making three graphs of the top three locations that had the most snowfall. In other words, they are going to look at the three areas that received the most snowfall:

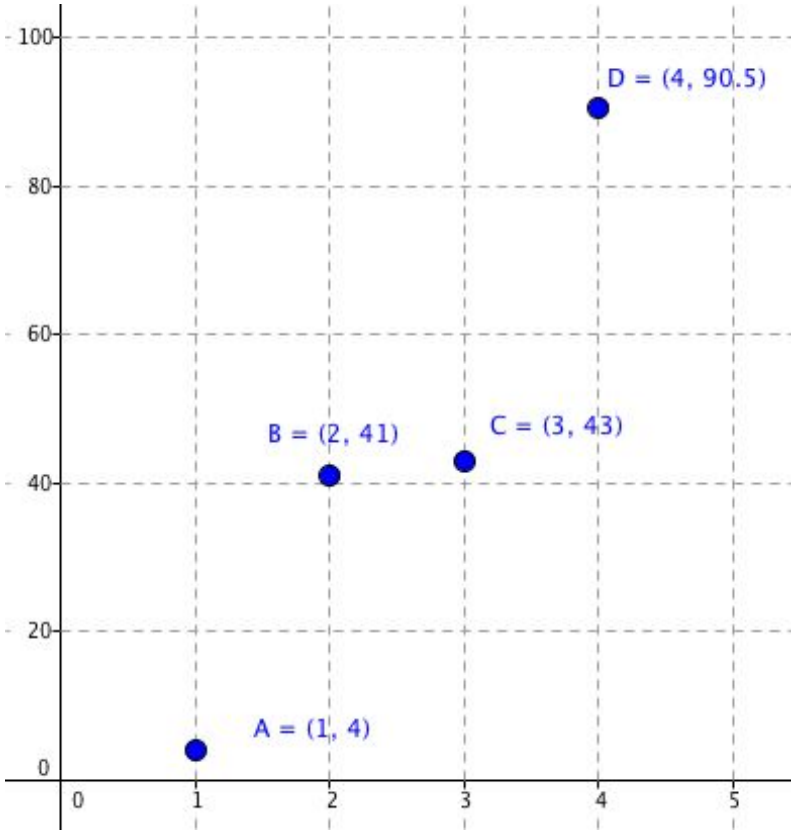
Follow this link to see a chart from Syracuse.com on New York snowfall totals: http://www.syracuse.com/news/index.ssf/2014/11/new_york_snowfall_totals_this_week_who_got_the_most_snow.html

Using the link provided, students can browse the top cities in detail. Then give them the Snow Accumulation Worksheet (also found in the materials section) to help them begin their graphing process:

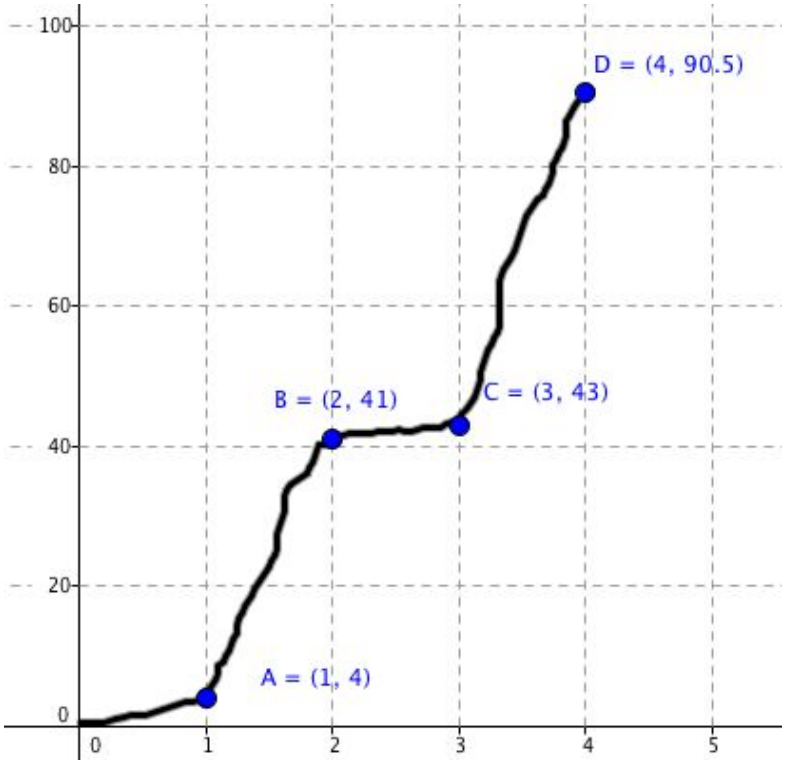
SNOW ACCUMULATION
NOVEMBER 2014

City	Monday	Tuesday	Wednesday	Thursday	Friday
EAST AURORA	4	37	2	47.5	0
Hamburg	0	18	32.5	12.5	17.2
Colden	2.6	4.2	7.4	10.6	31.5

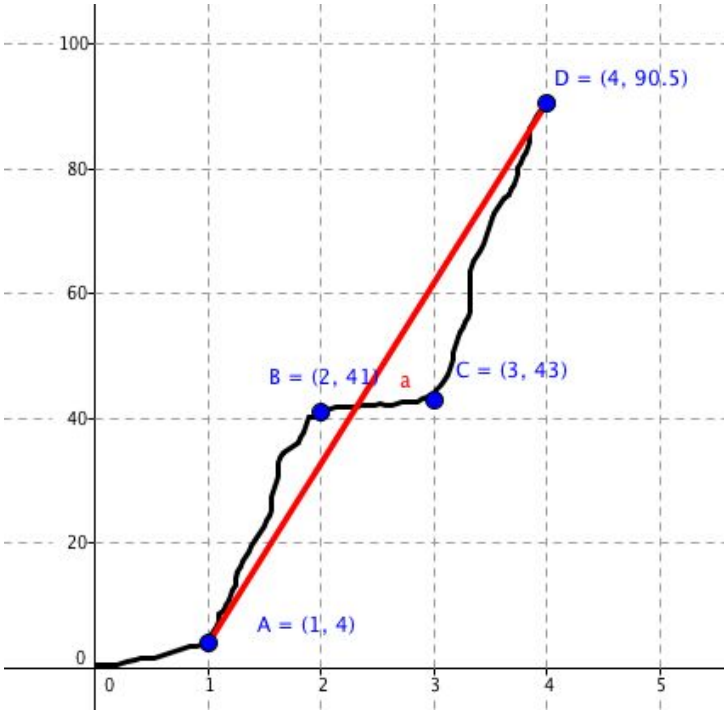
The goal is for students to set up a graph for each city. For example, they might start with the highest city on the list, East Aurora. To start, they would need to recognize that each day can be thought of as a number between 1 and 5. They might think of Monday as 1, Tuesday as 2 and so forth until Friday is set to 5. The y-axis, the dependent variable, can be set to *total* snow accumulation, not the just the amount accumulated on the day. In this lesson, you might only ask students to plot the points in which there was at least some accumulation. For East Aurora, this might mean that they only plot four points and omit the data point for Friday. They can approximate the graph points on graph paper or get more precise results on software like Geogebra (Geogebra.org):



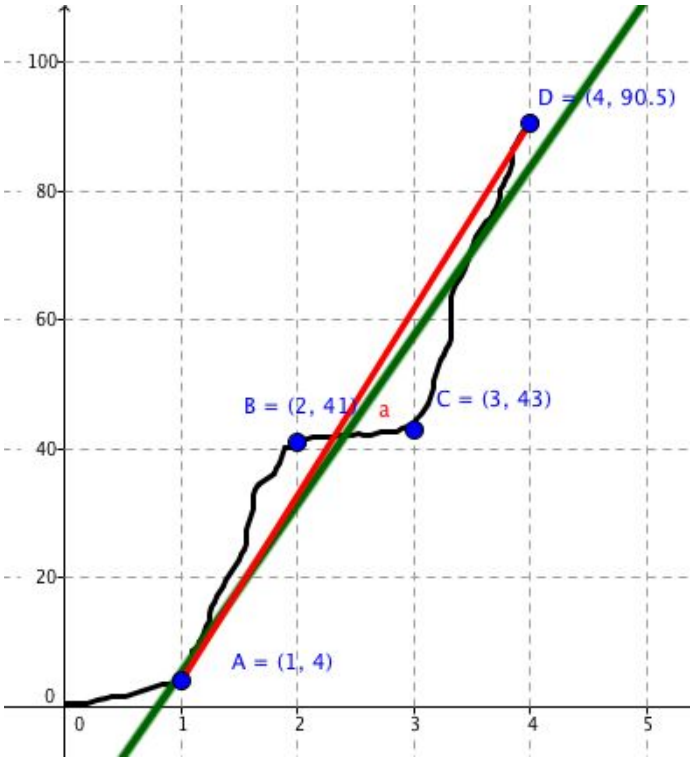
Next, students can draw two lines--one line to represent the trend they think might fit the actual data and another linear approximation that assumes constant growth, but with the same total accumulation. This is not a line of best fit, but it will help students model using a constant rate of change. It can be seen as a first step toward the line of best fit. The trend below might represent a student approximation of a reasonable snow trend:



On the same graph, students can draw a linear trend from the first point to the last point, represented here with the line in red:



Once students have set this up, you could also help them model with the line of best fit, represented here in green, and discuss why it isn't the same as a the red line:



A nice way to help students think about the line is to ask, "Which line is closer to the most data points--the red line or the green line?" Here it should be somewhat obvious that the green line is closer to both C and D, but a bit further from B than the red line. Since the green line minimizes the distance to the most points, it is the line of best fit. Students might also notice that the red and green line are both about the same distance from point A, but the green line is *dramatically* closer to C and thus best represents the *most points possible*.

Students can repeat this process for the other three cities on their worksheet.

Lesson Wrap-Up

To summarize, instruct students to compare their results from the four graphs. If students did not deal with the line of best fit for each data set, use Geogebra or a similar program to show them the lines of best fit in comparison to the other trends. Students should be able to articulate the slope and equation that best represents the red lines.

For example, with the above graph, students could use points A and D to calculate slope:

$$m = \frac{4-90.5}{1-4} = \frac{-86.5}{-3} = 28\frac{5}{6} = 28.8\overline{3}$$

Encourage students to confirm that we get the same result if subtracted in the reverse order:

$$m = \frac{90.5-4}{4-1} = \frac{86.5}{3} = 28\frac{5}{6} = 28.8\overline{3}$$

Ask: Why does the following approach give an incorrect result?

$$m = \frac{4-90.5}{4-1} = \frac{-86.5}{3} = -28\frac{5}{6} = -28.8\overline{3}$$

Students should articulate that you can find the difference between corresponding y and x values in any order, but you must be consistent in the order you choose. Students can use a calculator in their work, but could also use this as an opportunity to develop number sense. For example, many students will use a calculator to solve 4 – 90.5, but they need to recognize that 4 – 90.5 = -(90.5 – 4) and that 90.5 – 4 = 90 – 4 + 0.5, which is a much easier calculation to work with. Furthermore, when students find the quotient of 86.5 and 3, they should have *some* strategy for estimating and calculating. For example, they could think that 86.5 is close to 90 and 3 x 30 = 90. 86 is less than 90 and 84 is two groups of 3 less than 90, so 84 = 3 x (30 – 2) = 3 x 28. 86.5 is 2.5 (almost a full 3) above 84. Therefore, 86.5/3 = 28 and a remainder of 2.5. With this number sense, students could write:

$$\frac{86.5}{3} = 28\frac{2.5}{3} = 28\frac{25}{30} = 28\frac{5}{6}$$

Converting 5/6 to a decimal is *tough*. This is a non-terminating repeating decimal and might be something you only discuss if you have taught into it. However, reaching 5/6 is more than enough to finish the slope and might be easier to work with to generate an equation for the line.

Next, students can apply the slope to find an equation for the line. Here is one approach, starting with what we know:

$$y = mx + b$$
$$y = 28\frac{5}{6}x + b$$

Ask students, “Which points could we plug into this equation?” Or more directly, “Could you plug in points B and C?” Students need to recognize that you are generating a function that is only true for points on the line. Since B and C are not on the line, they are not a part of this process. However, we could generate a different slope and equation for a line crossing any combination of points A, B, C, and D. For this line, plugging in A might be easiest. Solving for b, the y-intercept, we get:

$$4 = 28\frac{5}{6}(1) + b$$

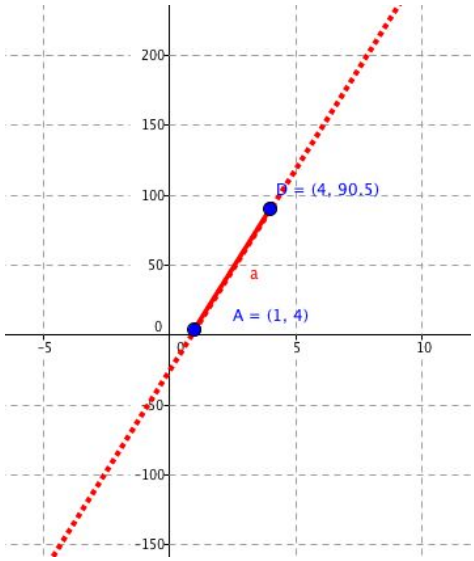
$$4 - 28\frac{5}{6} = b$$

$$-24\frac{5}{6} = b$$

Again, use this as an opportunity to discuss the number sense around the difference between 4 and 28 and 5/6.
Finally, we get our equation:

$$y = 28\tfrac{5}{6}x - 24\tfrac{5}{6}$$

Ask students, “Why did we get a negative y-intercept? How is that possible? Can you have a negative level of snow accumulation?” This is an opportunity to reinforce the process of modeling with mathematics. We have constructed a line that extends infinitely in both directions:



So, our model can extend beyond the physical situation. However, we know that the domain only applies between 1 and 4, and the range only applies between 4 and 90.5. Furthermore, you can talk about *why* this modeling is valuable. Help students understand how to use this line and equation to predict future snow accumulation (assuming that the rate of change is constant). For example, you might say, “If 100 days passed with the same rate of accumulation as indicated by our equation, how much accumulation would we have?” Using the graph and equation is much more efficient than counting up each day.

For the summary, you can repeat this process for the other cities included on the snow table worksheet found in the materials section.

Assessments

Depending on how this lesson is used, there are three assessments described below. Each assessment is provided in the materials section.

1. *New York Times article exercise.* There is so much context around news and weather that it is difficult to pick any one particular resource to analyze. However, one great digital assessment could be based on this New York Times article (http://www.nytimes.com/interactive/2014/03/05/nyregion/snow-depth.html?smid=tw-share&_r=2). The New York Times article and assessment found in the materials section will help students analyze the article. It asks them to first watch the animated clip and describe what they notice. Then it asks them to use other data from the article to support or contradict the assertion that the winter of 2014 was the worst ever.

2. *Snow and parking tickets exercise.* Use the worksheet for this assessment found in the materials section. It tracks snow accumulation over a longer span of time and also analyzes parking tickets during snow fall period in each of the five boroughs of New York City.

3. *Graphing snow exercise.* Another type of assessment might focus more on linear graphs and general snow trends. You could use a graphing assignment to establish their understanding in these areas.

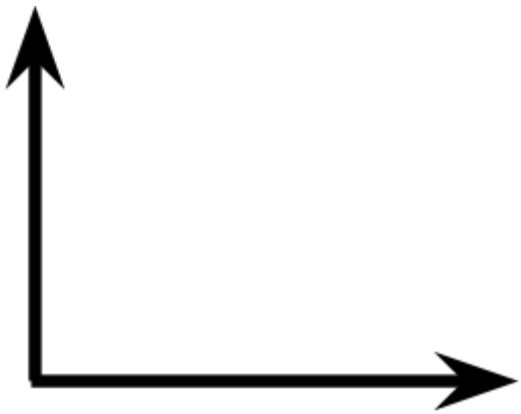
Materials: Buffalo Blizzard

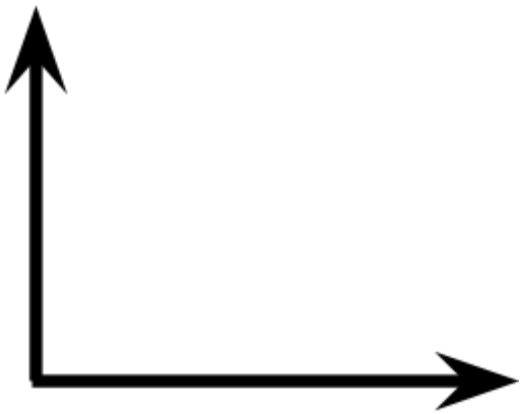
1. Snow Table Worksheet
2. Four Blank Graphs Worksheet
3. New York Times article assessment
4. Snow and parking tickets assessment
5. Graphing assessment with four graphs
6. Extension and Differentiation Ideas w/ Snow Accumulation Worksheet

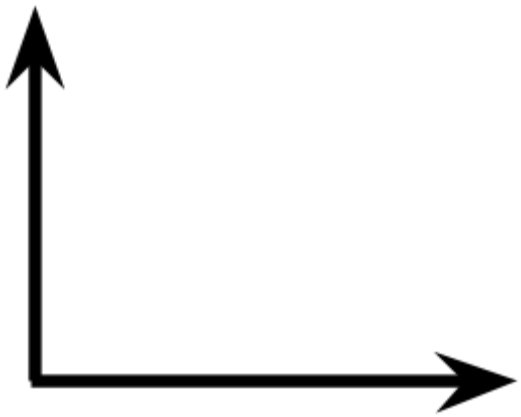
SNOW ACCUMULATION WORKSHEET
NOVEMBER 2014

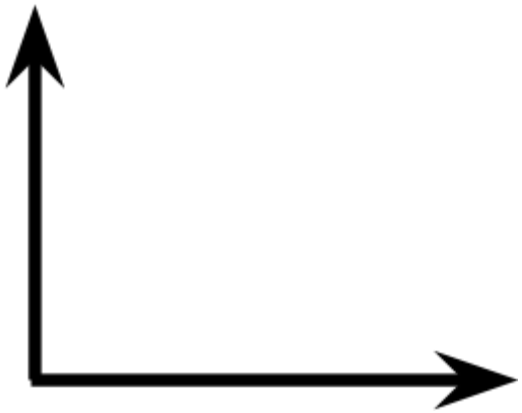
City	Monday	Tuesday	Wednesday	Thursday	Friday
EAST AURORA	4	37	2	47.5	0
Hamburg	0	18	32.5	12.5	17.2
Colden	2.6	4.2	7.4	10.6	31.5

Four Blank Graphs









Assessment 1: New York Times Article

Directions: Either individually or in groups, ask students to develop written responses to the following questions.

Question 1:

Watch the animated clip on this website and read the charts that follow:
http://www.nytimes.com/interactive/2014/03/05/nyregion/snow-depth.html?smid=tw-share&_r=1

Using the article linked here, pay attention to the different levels of snowfall for each map. The map shows the five boroughs of New York City as well as New Jersey and Long Island. What do you notice about the snowfall in these areas? How do they compare?

Question 2:

Using the same website above, look at the chart for Central Park. Many people complained that the winter of 2014 was the "worst ever!" How do the sequences of graphs in the chart support that argument?

Question 3:

Using the same website above, look at the graph for Islip, N.Y. Many people complained that the winter of 2014 was the "worst ever!" How do the sequences of graphs in the chart contradict that argument? The graph shows hourly snow depth estimated in inches from Jan. 20 to March 4.

Assessment 2: Snow and Parking Tickets

Directions: Using the websites and images found via the links below, respond to the following questions.

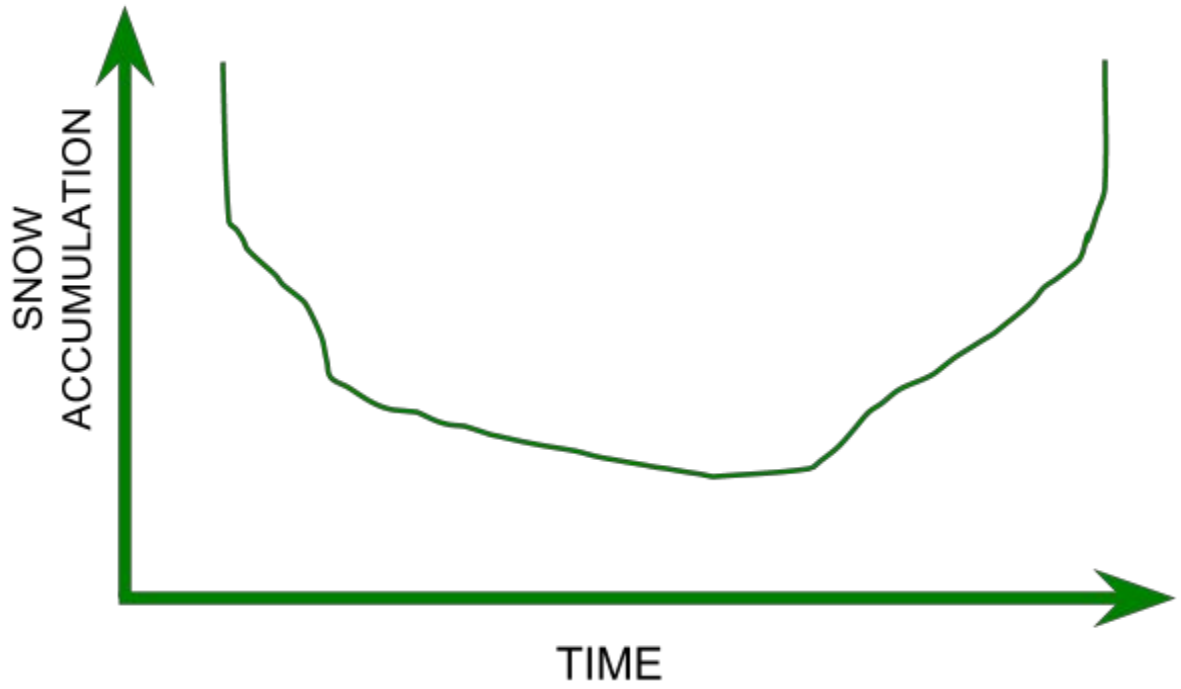
Question 1:
Use the link below to pull up a graph with the headline “Worst Winter Ever?” What do you think the graph implies. Why? Explain. Source: http://visual.ly/worst-winter-ever

Question 2:
Use the link below to pull up a second graph,titled “You can’t park your snow here buddy.” What does the graph represent? What does it tell you about snowfall in the five boroughs of New York City? Explain. Source: http://visual.ly/worst-winter-ever

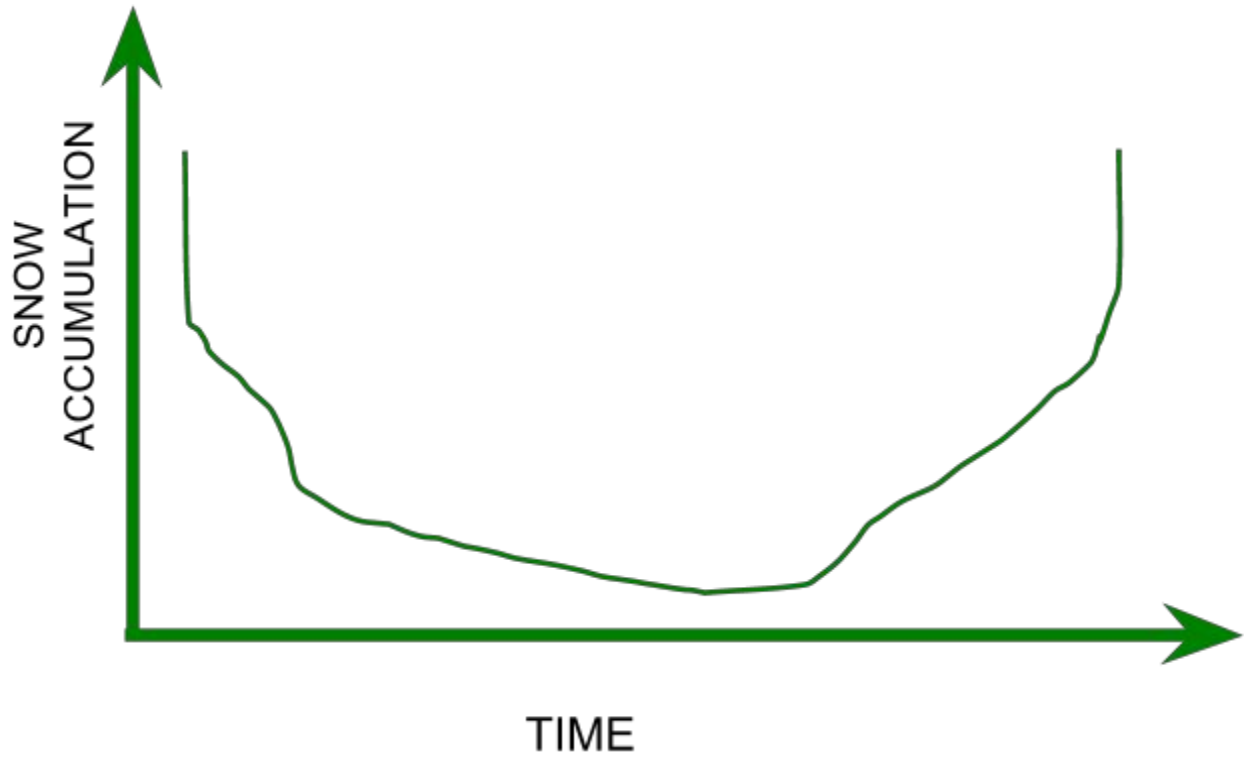
Assessment 3: Interpreting Graphs

Directions: Respond to the questions below by marking the appropriate text on each of the four graphs.

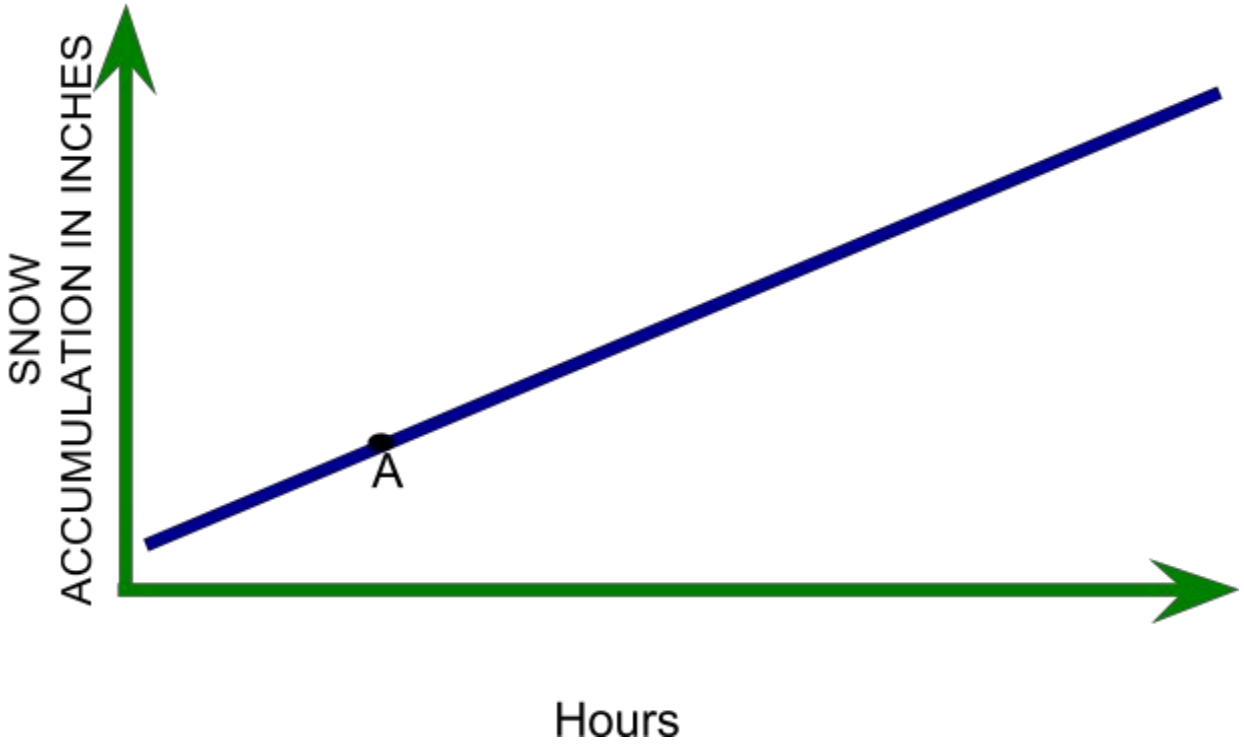
On the graph below, arrange the 12 months of the year to create a reasonable approximation of snowfall throughout the year.



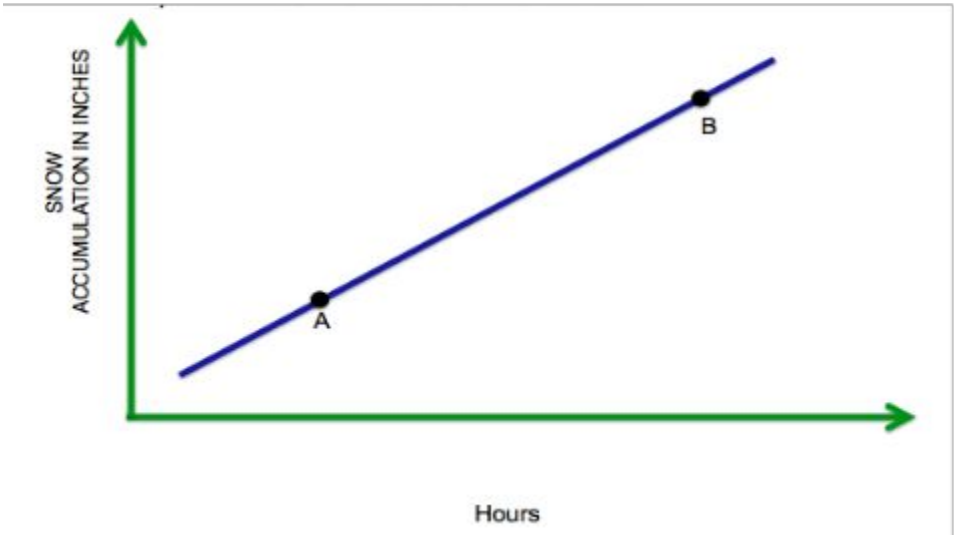
On the graph below, arrange the 12 months of the year to create a *unreasonable* approximation of snowfall throughout the year.



On the graph below, point A = (4,3) and point B = (15,9). What do the numbers 4,3, 15 and 9 represent in the context of this problem?



What is the slope of the line and equation that best represents the line. If the trend continued, how many inches of snow would there be after 100 hours?



Extension and Differentiation Idea

If you feel that the four cities clutter up this lesson, one basic modification might be to only analyze trends for one city.

Furthermore, you could adjust the numbers slightly to make the calculations *much* more manageable. On the extension worksheet that follows, students analyze East Aurora only and are given tables, graphs, and prompts with a total snowfall of 90” instead of the actual 90.5”.

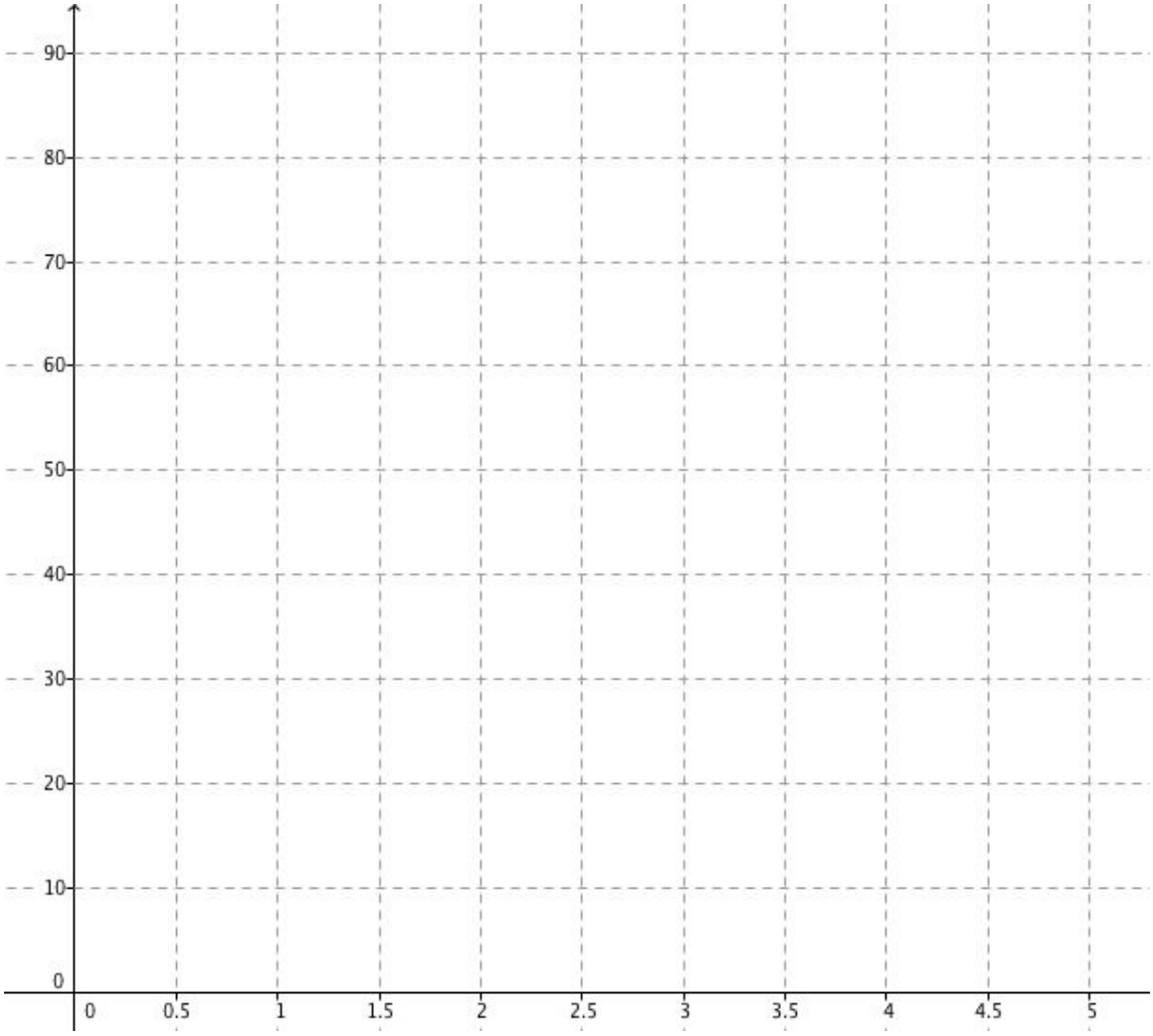
SNOW ACCUMULATION IN AURORA, NEW YORK
NOVEMBER 2014

Monday	**Tuesday**	**Wednesday**	**Thursday**
4	37	2	47

Represent this data in the table below. Remember to add the total accumulation in the column for y:

Day of the Week (x)	Total Accumulation (y)
1	4
2	
3	
4	

Now plot the four points on the following graph. Label the x-axis and y-axis:



Use a different color to approximate the actual snow fall throughout the four days.

Connect the first and last points and write an equation for the line that crosses those two points.

Further Resources

1. Complete table of snowfall in Buffalo: http://www.syracuse.com/news/index.ssf/2014/11/new_york_snowfall_totals_this_week_who_got_the_most_snow.html

2. Snow interactive: http://www.nytimes.com/interactive/2014/03/05/nyregion/snow-depth.html?smid=tw-share&_r=1

3. Snow data over a long period of time, including correlation to parking tickets: http://visual.ly/worst-winter-ever

4. Climate data on Buffalo: http://www.usclimatedata.com/climate/buffalo/new-york/united-states/usny0181/2014/11

5. Great article and photos on Buffalo snowfall: http://www.nytimes.com/2014/11/21/nyregion/snowstorm-western-new-york.html?_r=1

6. More articles and photos on Buffalo snowstorm: http://www.cnn.com/2014/11/19/us/winter-weather/

7. More on the lake effect: http://www.weather.com/storms/winter/news/lake-effect-snow-significant-lake-erie-lake-ontario-20141115

8. A great video of the snowfall: http://nyti.ms/1v4lqML

News Literacy Model Curriculum in Math
Grades 7/8

Lesson 2: All the Ants

Lesson 2

All the Ants

There are a lot of bugs on Earth. We may never know the exact amount, but we can think about the enormity of the insects within the framework of scientific notation. This process of estimating these wonderful numbers is at the heart of this lesson. When the exact value of our investigation is beyond our grasp, we can find a reasonable way to estimate the range of answers. If the total number of particles in the universe is of the order 10^{80}, we can say with certainty that the number of insects on Earth is less than this number. It would be absurd to think that the number of insects on Earth exceeds the number of particles on Earth. We can remind students here that insects are made of many particles and thus must be a number smaller than 10^{80}. We can also say that the number of bugs is more than 10^{2}, since we could easily recall a time that we have witnessed a colony of bugs larger than this number.

Although these estimations seem absurd, we have already taken an important step in thinking about an enormous number. We have contained it between other numbers. We can say, with certainty, that whatever the actual number of insects on Earth may be, it is larger than 10^{2} and less than 10^{80}. This is a lot further than saying "too many to count."

This lesson pushes this idea to another level and asks, "Do all the ants weigh more than all the humans?" The challenge of this question is based on a series of estimations from the BBC article, "Are all the Ants as Heavy as All the Humans?" (http://www.bbc.com/news/magazine-29281253)
The goal is to analyze and critique each estimation until students have reached an answer that they think is reasonable. This gives the class an opportunity to use exponents and scientific notation to support and critique the reasoning of others.

Grade Level: 7-8
Required Time: 120 minutes

Learning Objectives

Students will:

- Make sense of data in a news article.
- Use their understanding of ratios, proportions and scientific notation to construct an argument for or against an article in the news.
- Compare and contrast different estimates in an article.
- Use ratios, proportions and scientific notation to find a reasonable estimate of the weight of all the ants and all the humans on Earth.
- Use an article to support their estimate of weight.
- Students will use online research tools to aid in the fact-checking process.

Guiding News Literacy Question: How can students know what to believe?
News articles and especially content on ever-popular "shareable news" sites like BuzzFeed are often ripe with overstatement or claims of grandiose fact. By understanding the relatively simple math calculations behind these kinds of generalizations, young adults can be more critical of what media are accurate.

Common Core State Standards

CCSS.Math.6.RP.A1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."*
CCSS.Math.6.RP.A3	Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
CCSS.Math.6.RP.A3.c	Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
CCSS.Math.7.RP.A1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.
CCSS.Math.7.RP.A2.c	Represent proportional relationships by equations.
CCSS.Math.7.RP.A3.c	Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
CCSS.Math.8.EE.A1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 × 3^-5 = 3^-3 = 1/3^3 = 1/27.
CCSS.Math.8.EE.A3	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.

CCSS.Math.8.EE.A4	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.
CCSS.Math.8.SP.A3	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

Materials

Recommended Slideshow:
https://drive.google.com/file/d/0B5FTxsu-S1CoanRjNFN5QVhaNnc/view?usp=sharing

Worksheet, one per partnership or group:
https://drive.google.com/file/d/0B5FTxsu-S1CoanlrbnhMQXJGUkU/view?usp=sharing

Websites

BBC on ants
http://www.bbc.com/news/magazine-29281253

About Ants, National Geographic
http://animals.nationalgeographic.com/animals/bugs/ant/

Little Creatures Who Run the World
http://www.pbs.org/wgbh/nova/education/programs/2203_littlecr.html

Student/Teacher Preparation:

Students should be familiar with basic ratios and percents and have some basic skills for working with large numbers, either using scientific notation or some other approach, including a calculator.

Review the BBC article on this topic: http://www.bbc.com/news/magazine-29281253

Update World Population Numbers: http://www.census.gov/popclock/

Instructional Plan

Introducing the topic

As students enter the room, post the slide showing the cluster of ants. Let them look at it without talking. Encourage students to write about what they see before they talk about it:

Photo by Geoff Gallice and used here with Creative Commons license. Photo available at http://en.wikipedia.org/wiki/Bivouac_%28ants%29#/media/File:Army_ant_bivouac.jpg

Turn and Talk

Then give them a chance to turn and talk, which is a literal teaching move in which students have a minute or so to turn to their partner and talk about their ideas around a specific question. The move helps students build confidence and share their ideas and questions before the class share. A turn and talk will boost participation, since students often need a chance to hear what others think before they feel confident enough to share with the group.

In this case, the turn and talk is focused on the following questions: What do they think they are looking at in the above slide? What do they notice? It is very important to post the turn and talk questions and be clear about the expectations of the turn and talk session. In this case, students should know that they are spending a moment to just get out their observations and ideas. After about a minute, let the text “ANTS” fade in:

Photo by Geoff Gallice and modified here with Creative Commons license. Photo available at http://en.wikipedia.org/wiki/Bivouac_%28ants%29#/media/File:Army_ant_bivouac.jpg

Let students experience their authentic “eww gross” and “woah cool” responses. They might get a bit loud or distracted, but that is fine. You are building the hook around the content of this lesson. Then, let them know you are going to show them another image:

The slideshow layers the image in three parts: the ant first, then the human, and finally the scale upon which they are standing. The layering helps students think about the pieces of the problem throughout this lesson: all the ants, all the humans, and their weights. Explain that the images might seem disconnected, but their task is to write out a question that connects the three layers that built the image. Again, this is an activity that needs to happen on the individual level before they share.

Show the images slowly, layering in the ants, then the human, then the scale and finally the prompt “Write a question.” If the “write a question” prompt is too vague, ask students, “What could we ask about ants, humans, and a scale?” You could also say, “Why might an ant and a human be standing on a scale?” You might also phrase it in an open way, “I wonder if we can ask a question that involves ants, human, and scales?”

Turn and Talk

After they have had a minute or so to write out their questions that connect the images, show the “turn and talk” slide that indicates they will repeat the activity and share their question. This is critical, as it will boost their confidence in sharing. The more opportunities they have to get comfortable with their thinking on this lesson, the more participation and excitement you’ll see.

Defining the Problem
When they have had a moment to share, ask them to share their idea with the class. The teacher may want to pull up a text or word processing document and quote them. For example, if a students asks, “I was wondering if there is an ant in the world that weighs as much as a human?” type or paraphrase their idea along with their name:

“Is there an ant in the world that weighs as much as a human?”
-Beth

To see this teaching move in action, see Dan Meyer at this lecture (https://www.youtube.com/watch?v=YG9oqlQdVp0&feature=youtu.be). He has clearly mastered this move. You will notice that this teaching move *dramatically* increases class participation. You are acknowledging the inherent value in their ideas and publishing them to the class. You are broadcasting and validating their thoughts. Furthermore, you are *building* the question together. This is more powerful than any presentation of a pre-packaged question.

The questions they give might meander a bit, but you will invariably get something toward your goal of asking, “Do all the ants weigh as much as all the humans?”

When you have reached the question you want, highlight it and rephrase it with the three slides below:

Contextualizing the Problem
Once we have defined the problem, students need to think about the information needed to solve the problem.

Ask them the question directly and list out their thoughts: “What do we need to solve this problem?”

This move is articulated nicely by Dan Meyer and others as part of the three-act lesson structure (for more, see: http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/).

Students might name lots of random bits of information they think they need to solve the problem or ask for very specific bits of information, such as, “We need the total weight of all the ants and the total weight of all the humans.” This is a totally appropriate comment and gives you a chance to back-peddle and help them think about the pieces of information needed to get those totals.

“How would we go about figuring the total weight of all the ants? How would we go about figuring the total weight of all the humans?” Here you are getting them to think about the process of estimation and the need to sample a dynamic population.

Solving the problem
Once they have requested the appropriate information, pass out the worksheet and set them to work. This worksheet contains all the information they would need to go about solving the problem. A teacher guide is provided in the materials section.

Using news media to pinpoint information
After students have completed the worksheet, instruct them to read the BBC article connected to this lesson. Students might be surprised that the BBC wrote an article comparing the weight of all the ants to all the humans. We can use this surprise as a hook and opportunity to discuss the role of news literacy and specifically our guiding news literacy question: *How can students know what to believe?*

As students read the BBC article, ask them to compare the BBC’s process of problem-solving to their own. Can they follow the mathematical process the BBC used to weigh all the ants? Why would it be helpful to news consumers to see these kinds of math processes play out in the news media?

Ask students additional questions to encourage them to consider how math skills might help them to better understand certain types of news stories:

- Why would the BBC bother to publish this kind of article?
- Is it important to write news about science and math, and not just the everyday news events?
- What do they think the purpose of this article is?
- Who is the audience for an article like this?
- Is a British entomologist the right source to be giving expert advice/information on this topic?
- Could they think of a better source for the article?
- Do you think any source really *knows* the exact number of ants on Earth?
- What estimations are used to calculate the number? Why are estimations sometimes helpful or hurtful to accurate calculations?
- When are we able to know the exact population of a group? How could we use our own process that you just completed to fact-check this article?

As a class, see if you can replicate the entomologists' calculations using the information in the BBC article. What numbers or figures from the article would students use to do so?

There may not be exact answers to the above questions, but students need to understand that the role of the news media is to report all events and ideas. The news media reports on science and math all the time because they are a fundamental part of cultural, political, and social trends. Science and math allow us to think deeply about our world.

The questions around the source for the article bring out the idea that no one person could make such a complex prediction in an exact way. The fact that any person would give such an exact number is absurd. Instead, a person might give a reasonable range of values for the total number of ants on Earth, in the same way the the students focused on making reasonable estimations on their worksheet.

Lesson Wrap-Up

The summary of a lesson always follows from the observations you have made during the middle of the lesson. Try and gather a collection of interesting estimates for class discussion. Grab some predictions that are relatively high in the class and some that are relatively low. The idea is to start the summary conversation around their arguments in support of their estimates.

For example, some students might say, "We modeled this problem by thinking of the weight of ant as 10 mg. Then we multiplied that by a high estimate of the ant population. This gave us an upper limit to our estimate."

They might show that if an ant weighs 10 mg and there are 10^{16} of them, then they weigh a total of 10^{17} mg. This number could serve as an upper limit to your class discussion. Of course, some students might give an even higher result. If they do, make sure they are simply able to defend their choice. For example, if a student thinks that one million trillion isn't high enough, they might choose a billion trillion. If they do this, ask questions like, "Why did you raise the number?" You could also ask about how their estimate compares to one million trillion. "How many times larger is a billion trillion than a million trillion?"

Take a similar approach with the lower estimates given from the class. Make sure students are able to defend their calculations and their reasoning.

Repeat the process with their estimates for human weight and then list the ranges on the board. This will serve as a visual guideline to their debate around the numbers. A big idea is that there clearly isn't one right answer here and that there is room for debate. This is a big moment for students. Especially those who are convinced that math is about getting one right answer and that's it.

After students have had a chance to discuss their reasoning, return to the original question, “Do all the ants weigh as much as all the humans?” The goal is to get students to realize that the answer depends upon the estimate and model you use to think about the total number of ants. For example, a high estimate for ants will certainly surpass a low estimate for humans, but a high estimate for humans will certainly surpass a low estimate for ants. Help students understand this by seeing how the numbers compare. If we compare the high estimate for the ants, the weight of all the ants and all the humans are *surprisingly close*.

For example, the estimate for total adult human weight is about 3.34E+11 kg and about 6.6 E+11 kg for all humans. The weight range for ants is between 2E+14 mg and 1E+17 mg. Students need to recognize that a kilogram is a million times larger than a milligram. So the ant range can also be written as 2E+8 kg and 1E+11 kg. This means that the human population is as little as three to six times heavier or over a thousand times heavier: That is quite a range!

Contrast this finding to the initial consensogram and see how the two results conflict.

“How many of us originally thought that the ants weighed more?”

“Has anyone changed his or her mind after seeing these calculations? Why?”

Materials: All the Ants

1. Worksheet
2. Worksheet Teacher Guide
3. Assessment Idea
4. Rubric
5. Extension and Differentiation Ideas

Worksheet: How Much Do the Ants Weigh?

Directions: With your partner, respond to the following questions and show your work.

Part 1: The BBC article writes, “British entomologist C.B Williams calculated that the number of insects alive on Earth at a given moment was one million trillion. Write this number in scientific notation.

Part 2: If 1% of the insect population consists of ants, how many ants would there be? Show your work.

Part 3: In the The BBC Four documentary, one claim for the number of ants is 100 trillion. Write this number in scientific notation.

Part 4: So how many ants do you think there are? Give a reasonable range below.

High Estimate:

Low Estimate:

Now, read the three quotes from the BBC article below and address the synthesis question at the bottom of the page.

> QUOTE 1:
> Individual workers weigh on average between 1 to 5 mg, according to the species.
> QUOTE 2:
> The common ants which live in British gardens weigh about 1 mg or 2 mg.
> QUOTE 3:
> It's probable their weights vary greatly--though most experts seem to agree the average weight of an ant is less than 10 mg.

Synthesis Question:
Use all of the information given so far to construct a reasonable estimate for the total weight of all ants on Earth. Include a high number, low number, and best estimate.

All the Ants Worksheet
Teacher Guide

The worksheet provided here is intended for partner work, but it can be used individually or in groups. The worksheet focuses on the mathematical modeling of the problem. The first part of the worksheet helps students think about the number of ants on Earth:

Part 1: The BBC article mentions how a British entomologist, C.B William, calculated that the number of insects alive on Earth at a given moment was **one million trillion**. Write this number in scientific notation.

Here students are converting between standard/decimal form and scientific notation. Help them avoid language such as, “I moved the decimal point left and right.” Although it isn’t incorrect to talk about how they moved the decimals as they rewrote the number in scientific notation, they do need to understand that they are maintaining equivalence.

For example:
one million trillion = one million x one trillion = $10^6 \times 10^{12} = 10^{6+12} = 10^{18} = 1 \times 10^{18}$

Part 2: If 1% of the insect population consists of ants, how many ants would there be? Show your work.

This question is significantly more difficult, but students can access the 1% number by dividing by 100. Since 1% is a landmark percent, many students can access the problem. You can modify the difficulty here by asking extension questions such as, “What if 5% of the insect population were ants?”

Students might show their work like this:

1E+18/1E+2 = 1E+16

Part 3: In the The BBC Four documentary, one claim for the number of ants is 100 trillion. Write this number in scientific notation.

Again, students are converting between standard/decimal form and scientific notation. Help them avoid language such as, “I moved the decimal point left and right.” Although it isn’t incorrect to talk about how they moved the decimals as they rewrote the number in scientific notation, they do need to understand that they are maintaining equivalence.

For example:
100 trillion = 100 x one trillion = $10^2 \times 10^{12} = 10^{14} = 1 \times 10^{14}$

Part 4: So how many ants do you think there are? Give a reasonable range below.
High Estimate: 10^{14} Low Estimate: 10^{16}

You might use this opportunity to compare this estimate to the first and ask, “How many times larger is this estimate?” Many students tend to compare exponential relationships additively, thinking for example that 10^4 is twice as large as 10^2, instead of realizing that it is two powers of 10, or 100 times, larger. The comparison in this problem is a bit more challenging, but you can use any example as an analogy. In this case, one estimate is also 100 times larger than the other. Check and see how students respond to this. Ask, “Did you notice that these estimates are 100 times apart? Do you think that such a range is acceptable?”

The next part of the worksheet helps students estimate the total weight of all the ants. It starts by giving them three quotes:

QUOTE 1:
Individual workers weigh on average between 1 to 5 mg, according to the species.
QUOTE 2:
The common ants which live in British gardens weigh about 1 mg or 2 mg.
QUOTE 3:
It's probable their weights vary greatly--though most experts seem to agree the average weight of an ant is less than 10 mg.

As you circulate, use this opportunity to discuss the importance of checking on the numbers used in an argument. Numbers and sources are often used loosely and inaccurately. Ask students how often they “just accept the numbers used in something they read.” Ask, “why might it be important to check on the numbers and the algorithms used to calculate data?” The importance can often be emphasized in different ways:

- People make mistakes all the time checking their work raises the level of discourse and quality of work.
- People lie all the time; checking their work helps identify the truth in a given situation.

Finally, the worksheet includes a synthesis question:

Synthesis Question
Use all of the information given so far to construct a reasonable estimate for the total weight of all ants on Earth. Include a high number, low number and best estimate.

There are a variety of answers that students can use here. As a facilitator of the process, you should encourage them to choose an estimation that seems reasonable to them. Most likely their answers will range from a high of 10^{16} ants x 10 mg per ant =10^{17} mg and a low of 10^{14}

ants x 2 mg per ant = 2 x 10^{14} mg. You might help students think about why 1 x 10^{14} seems to be too low of an estimate by explaining that “we know many ants are larger than 1 mg, so it seems unreasonable to use 1 mg per ant.” 2 mg per ant might be a more reasonable estimate since the average weight of ants must be above the lowest number given. This could bring about a whole conversation around averages. You could ask, “Does an average ever equal the values given at the extremes?” Students could then discuss that the only way that could happen is if all the values were equal. Any variance would preclude that possibility.

Finally, students construct a weight for all the humans on Earth using a table of census data.

They are given an average:
Average Human Adult = 62 kilograms. Write this number in scientific notation.

And they are given this excel table from the U.S. Census (this source):

AGE	BOTH SEXES POPULATION	MALE POPULATION	FEMALE POPULATION	SEX RATIO
Total	7,228,296,734	3,638,522,032	3,589,774,702	101.4
0-4	632,588,603	326,339,256	306,249,347	106.6
0-9	1,244,294,671	316,273,665	295,432,403	107.1
0-14	1,841,870,307	309,344,873	288,230,763	107.3
0-19	2,433,572,158	305,700,016	286,001,835	106.9
0-24	3,025,906,045	304,317,472	288,016,415	105.7
0-29	3,619,851,060	303,294,657	290,650,358	104.4
0-34	4,162,208,872	275,863,147	266,494,665	103.5
0-39	4,659,348,002	252,474,140	244,664,990	103.2
0-44	5,143,457,017	244,979,143	239,129,872	102.4
0-49	5,596,307,966	227,656,648	225,194,301	101.1
0-54	5,993,447,821	196,990,701	200,149,154	98.4
0-59	6,327,768,489	163,990,049	170,330,619	96.3
0-64	6,613,945,245	138,267,276	147,909,480	93.5
0-69	6,831,048,772	103,343,784	113,759,743	90.8
0-74	6,986,352,612	71,657,049	83,646,791	85.7
0-79	7,102,383,278	50,641,555	65,389,111	77.4
0-84	7,174,495,873	29,345,231	42,767,364	68.6
0-89	7,211,407,062	13,245,673	23,665,516	56
0-94	7,224,804,808	3,977,231	9,420,515	42.2
0-99	7,227,763,476	717,910	2,240,758	32
All	7,228,296,734	102,556	430,702	23.8

You might consider giving this table via Excel so that they can tally up the totals they need quickly and efficiently.

If Excel is not an option, provide calculators to tally up a range of subtotals that gives a reasonable number for the adult population. Since this is a cumulative frequency table, you could also support students by simply giving them the number for the adult population.

You might also consider this table to build other questions into the lesson. You could focus on the weights of certain age groups. For example, the students could consider the weight of the entire adult population. If we consider 15-19 a starting age for adulthood, students might just subtract the 0-14 range from the total range: 5,386,426,427.

If this is overwhelming or tedious, you can encourage students to estimate. For example, there are about 7.2 billion people and about 1.8 billion in the 0-14 range, so we have about 5.4 billion adults.

Since each adult is about 62 kilograms, the weight of the total population is: 5.4 billion adults x 62 kilograms per adult = 334.8E+9 kg.

More precisely, the weight is 3.33958E+11 kg.

If we look at all humans, that number pretty much doubles to 6E+11kg.

Assessment

Ask students to do some online sleuthing to find another news article that focuses on estimations. Once they've found the article, they should respond to the following questions:

1. What is the author/reporter attempting to estimate?
2. Who are the main sources of information?
3. What numbers or figures are important to this estimation, and what are the sources for those numbers?
4. Are those sources reliable?
5. Can you attempt to calculate the estimation given the numbers provided? If so, explain and show how you would go about calculating your estimate. How successful were you? If not, what additional information might you need?

These questions mirror the investigation of the lesson and will give students a chance to reflect on the lesson itself. Their response to this question could also serve as an assessment, since their ability to respond is directly connected to the mathematics covered in the lesson. A rubric for assessing their responses is on the next page.

Assessment Rubric

	Exceeding Standards	Meeting Standards	Approaching Standards	Falling Below Standards
Precision	Meeting standards and students show multiple approaches to the problem	Student accurately answers the question using precise estimation and examples from article	Some more inaccurate	Work not yet precise
Reasoning and Proof	Meeting standards and explanation reflects a deep understanding of the problem	Students clearly explain their thinking	Some explanations unclear	Reasoning and proof not yet clear
Representation	Meeting standards and work is clear enough to share with other students	Students create accurate diagrams, tables, lists or pictures to give a clear answer	Some representation unclear	Representation not yet clear

Extension and Differentiation Ideas

1. Once students have had a chance to think about the range of possibilities within the modeling and estimation process surrounding this problem, have them read the BBC article and respond to the article. You could even give them specific follow-up questions such as, “The author seems to imply that any conclusion around the total weight of the ants is unreliable. What are your thoughts on this? Is there a way to estimate the total weight of ants even if we may not be able to get a precise and consistent measure?”

   This question mirrors the investigation of the lesson and will give students a chance to reflect on the lesson itself. Their response to this question could also serve as an assessment, since their ability to respond is directly connected to the mathematics covered in the lesson.

Further/related resources
All about ants
http://insected.arizona.edu/antinfo.htm

Crazy Ants, A truly amazing article that could be a precursor to the lesson
http://www.nytimes.com/2013/12/08/magazine/crazy-ants.html?smid=pl-share

News Literacy Model Curriculum in Math
Grades 7/8

Lesson 3: Counting the Hungry

Lesson 3

Counting the Hungry

As global citizens, students need to recognize the vital role of mathematics in confronting major world issues. World hunger is clearly a major issue, but to what degree is it an issue? Who suffers from it, and how often do they suffer? These questions are an essential part of solving the hunger problem, and mathematics can help access the answers.

Like any real problem, the answers to world hunger are neither clear nor neat. Questions around world hunger do not simply fit into a multiple-choice format. Consider the most basic task of identifying how many people are hungry. Students should recognize that small changes in the approach to counting the hungry translate into hundreds of millions of differences. That affects funding, planning, and responses of organizations around the world.

In this lesson, students will review data on world hunger and analyze the way in which world hunger is measured. The goal of this lesson is to help students have a deeper understanding of world hunger through the lens of problem solving in mathematics. The key is to help students recognize that although mathematics can illuminate complex social situations, there is always room for debate and conjecture. In this lesson, the debate and conjecture will mostly focus on the way in which the hungry are counted and the extent to which hunger affects people around the world. Students should understand that although an exact number of hungry people can never be found, the degree of the hunger problem can be reasonably estimated. As students synthesize all of the information in this lesson, the natural question shouldn't be, "How does math apply to world hunger?" but "How could the problem of world hunger be understood without mathematics?"

Grade Level: 7-8
Required Time: 60 minutes

Learning Objectives

Students will:

- Use their understanding of scientific notation to grapple with the complexity of counting world hunger.
- Examine a wide range of estimates and discuss some of the statistical methodologies used in the counting and surveying of the hungry.
- Use ratios and proportional reasoning to track the progress of the United Nations Initiative of "halving the proportion of people who suffer from hunger."
- Use news media to keep informed on local/national events.

Guiding News Literacy Question: What challenges and opportunities do the Internet and digital media create?
In a world of seemingly infinite amounts of information, using digital media to become more informed about the world is a prerequisite to digital citizenship. By using the Internet to research questions of global significance, students become more aware of significant issues facing people around the world and perhaps even in their own neighborhoods.

Common Core State Standards

8.EE.A3	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. *For example, estimate the population of the United States as 3 times 108 and the population of the world as 7 times 109, and determine that the world population is more than 20 times larger*.
8.EE.A4	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.
6.RP.A3	Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole given a part and the percent.
7.RP.A2	Recognize and represent proportional relationships between quantities
Standards of Mathematical Practice 1	Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution.
Standards of Mathematical Practice 3	Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments.

Materials
Counting the Hungry PowerPoint
Projector

Hunger Video:
http://youtu.be/0W2Ic5hV28w

Printouts
Class set: Hunger survey
Class activity: World hunger worksheet

Preparation
To gain background on the issue of counting the hungry, the teacher should review The New York Times article around which this lesson is based:
http://nyti.ms/1sDbgn5

To get a sense of dissent from the above article, the teacher should review the opinion response:
http://nyti.ms/1rNqvIf

Students should have some experience adding, subtracting, multiplying, and dividing scientific notation through estimation and precision and with technology.

Websites
These sites can be used for further research by students and teachers. There is so much we can analyze around world hunger. Most of the work in this lesson is based off information from these sites.

Food and Agricultural Organization of the United Nations
http://www.fao.org/home/en/

World Food Programme
http://www.wfp.org/hunger/stats

The Hunger Project
http://thp.org/knowledge-center/know-your-world-facts-about-hunger-poverty/

New York Coalition Against Hunger
https://nyccah.org/

Instructional Plan

Building background

As students enter the room, give them about five minutes to read through the food-insecurity survey, (You can hand it out as they enter or have it laid out on their desks.) After reading through the survey, they should consider the statement posed and write their prediction on both the worksheet and on a sticky note. The statement is:

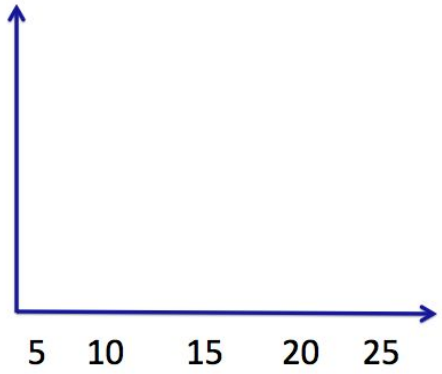
In New York City, I think that _____ out of every 100 kids are food insecure.

Students can write any rational number in the blank spot, but you might also consider asking them to write only whole numbers. (Whole numbers might help on the upcoming consensogram and discussion.)

Turn and talk

After every student has had enough time to process the survey and make their own prediction, let them turn and talk about the survey and their prediction with their partner. The prompt can be, “When you and your partner are ready, turn and talk about your prediction. Why did you pick the number you did? What makes your number a reasonable estimation?”

As they discuss their ideas, collect the sticky notes and begin to create a consensogram, which is a visual graph of their predictions. Draw an x- and y-axis on a whiteboard or on chart paper. Then stick their predictions on this graph. It will be a type of bar graph with percentages on the x-axis and frequencies on the y-axis. It would look a bit like the example below:



As they discuss ideas, populate the graph with their sticky notes. This creates a visual of their ideas and will serve as a basis for debate and discussion. Consensograms can be used in all kinds of ways. The blog www.growingexponentially.wordpress.com has some great examples. You can see an example here (or type in https://growingexponentially.files.wordpress.com/2013/08/photo-16.jpg.

When you have finished setting up the consensogram, transition to a discussion by discussing the variation in their predictions.

Ask, “I noticed that some of you picked higher numbers, such as 40%. Could someone share why they might have picked such a high number?”

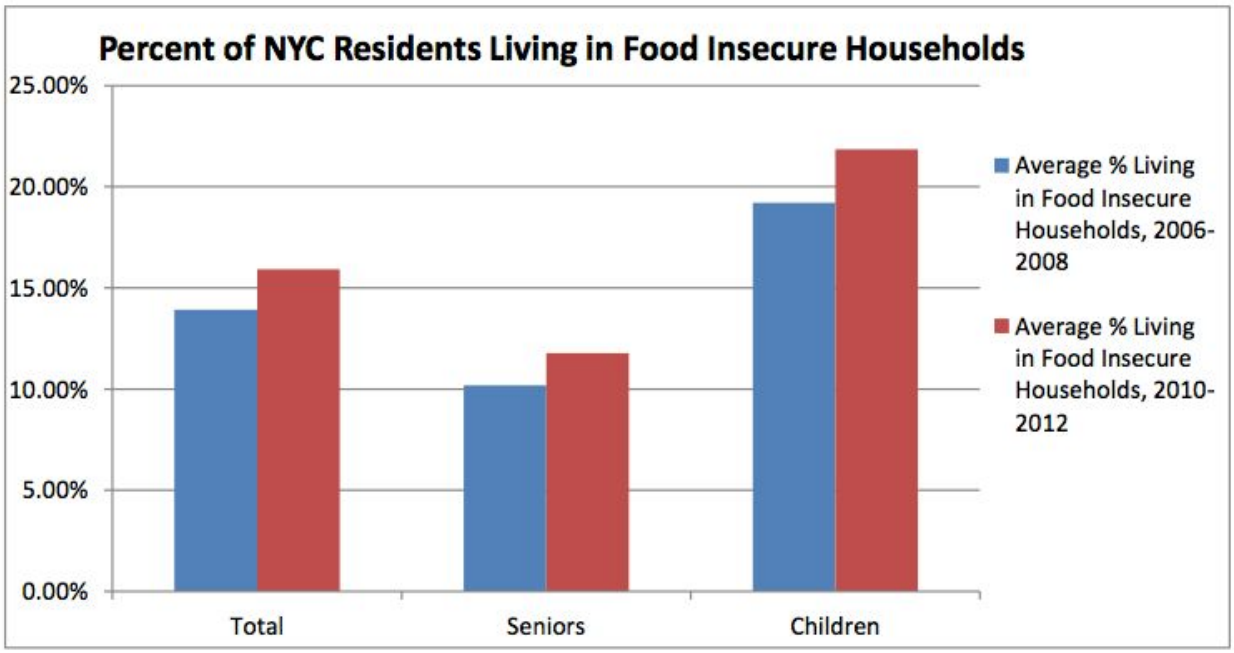
After they share, encourage someone who chose a much lower number to also share. “I also noticed that many people picked lower numbers; could someone who chose about 5% share their thinking?” The goal is to get students to share opposite views and create conflict in the class consensus. If everyone agrees or you find that a lot of people chose similar numbers, then the discussion can be quick, but if there is a lot of variation in their predictions, then you can harness that into a great discussion.

Addressing hunger issues

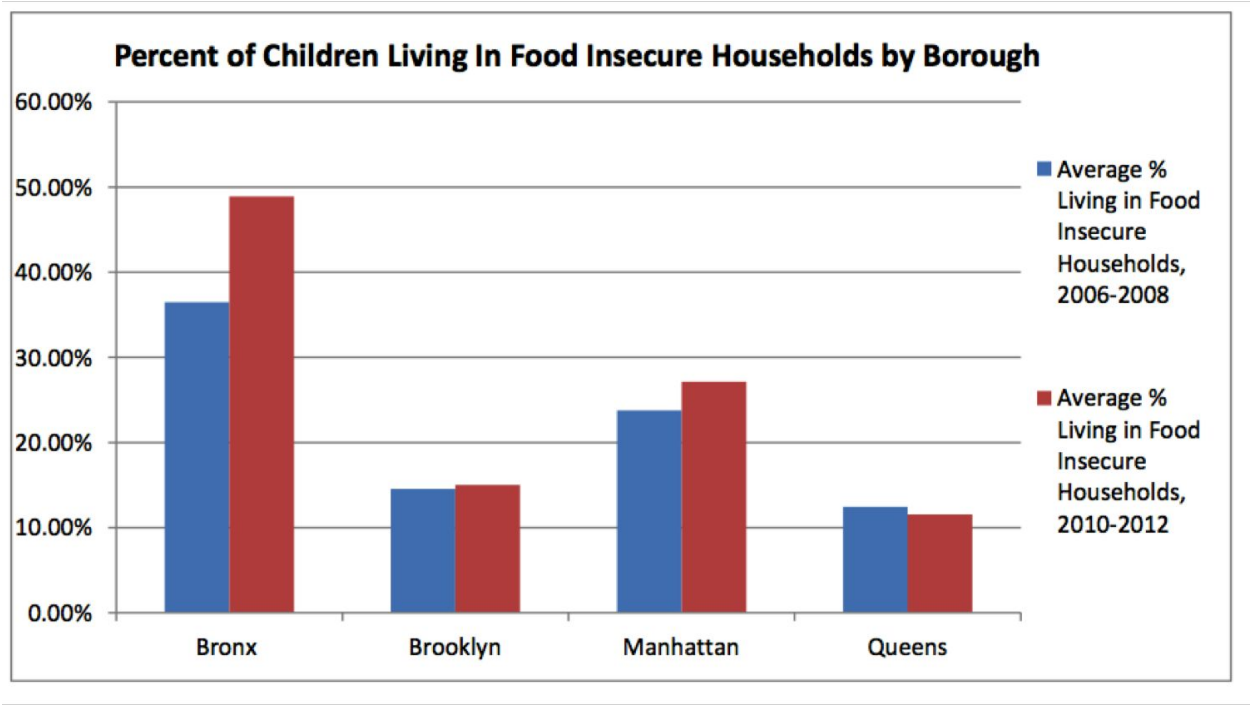
Open the PowerPoint, and once the momentum of the discussion begins to wane, show them the definition of “food insecure.”

> USDA defines **“food insecure”** as the condition under which “at least some time during the year, the food intake of one or more household members was reduced and their eating patterns were disrupted at times during the year because the household lacked money and other resources for food.”

Use the projector to show the percentage of food insecure children in households in New York City:



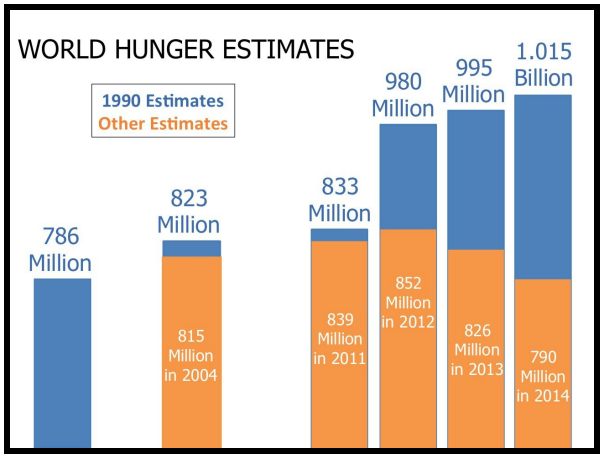
Before sharing details, ask them to write down their observations regarding the charts. After a minute or two, ask them to turn and talk and share their observations. When students turn and talk, they literally turn and then talk to their partner about their ideas. This builds up their confidence for class discussion. Once the turn and talk is finished, discuss their observations as a class. Students will notice that children are disproportionately affected by hunger in New York City and that the total number of hungry people seems to be increasing over time. Embrace these types of observations. Looking at trends will help students think about the investigation in this lesson. Follow up the discussion by showing this breakdown by borough on the projector:



Finally, give students a few minutes to respond to the final question on their survey. Collect their responses and play this transitional video on hunger: http://youtu.be/0W2Ic5hV28w.

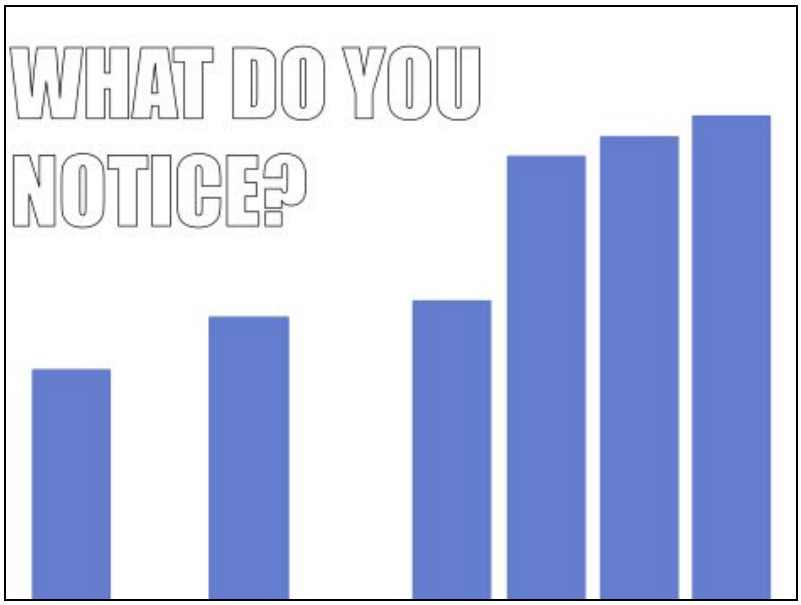
Applying math to develop understanding

As the video ends, begin with a transitional statement, such as, “Hunger is clearly a problem, but how many people are hungry? Can we know the exact amount?” Use the projector and switch to the next slide of the PowerPoint. Add in the layers of the graph to help students develop their intuition:



Allow students to develop their intuition around each layer of the graph. Use low inference questions, such as, “What do you notice?” Then build toward the complexity of the graph.

Start with this image, in which each bar represents the estimated number of hungry people in the world circa 1990:



In this first shot, there is no complexity. No title or axis or numbers to confuse the simple visual that students *need* to recognize in order to think about this graph. Give students about a minute to write out their noticings and then share.

Ask, “What did you notice?” Copy some of their observations to the board.

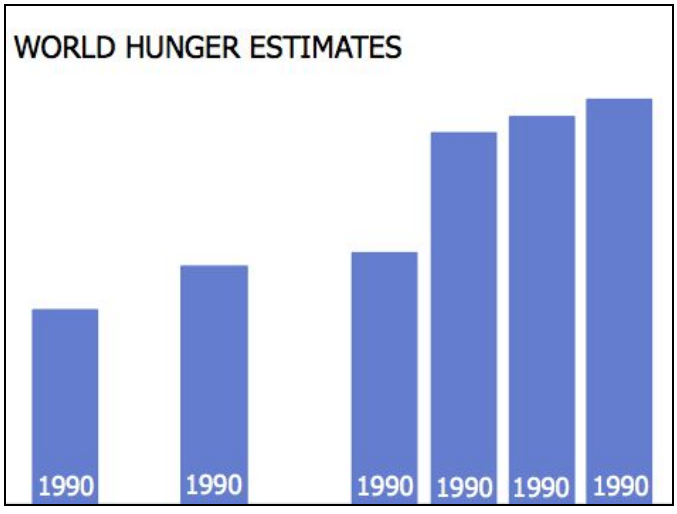
Each of these observations will build into further discussion. When the first student notices that the first two bars are spaced farther apart than the others, this connects to the spacing of the

years. The first two bars represent measurements in about 1990 and the other four bars take place in 2011-14. The second and third students' observations might be that the bars tend to increase, which connects to the critical idea that each new perspective on the 1990 hunger numbers leads to higher results.

Next, show this image, and add in only the title as a new layer of complexity:

Since they have already had a chance to think about the bars without context, give them a minute to think about questions they have. Ask them, "What do you wonder about this data?" Students are incredibly perceptive, and these low-inference questions give them a chance to show their creativity and curiosity.

There is no need for much discussion here because layers of complexity are still being added. Hopefully these layers will begin to naturally address their questions.



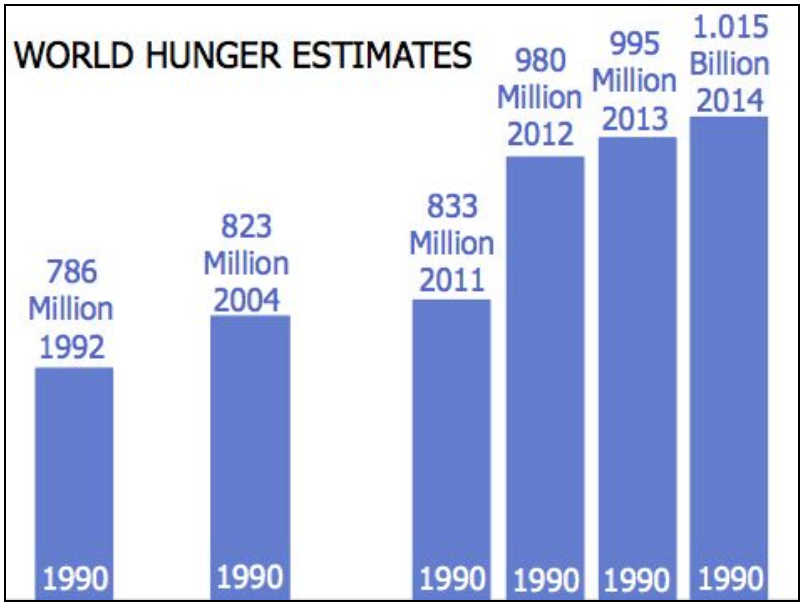
This one is a bit bizarre, but it is essential for them to understand the problem at hand. In this slide, we see that each bar represents measurements from the same year, yet somehow they are seemingly different. To get right at this issue, ask, “What is weird about this graph?” Encourage students to share their observation with the whole group.

They might say, “It is weird that each bar represents the same year and that they seem so different.”

Ask, “Why might this make sense?” How could there be different measurements from the same year?”

Possible answers: “Maybe each measurement was from different groups or surveys.” “Maybe they were taken at different times of the year.” “Maybe they were taken in different parts of the world.” “Maybe they are only slightly different.”

To help them, add another layer of complexity. The nice thing here is that this process gives students a chance to develop their intuition and almost ask for the next piece of information. They are basically asking about the numbers and details for each bar. Fade in the date one bar at a time and then talk about the image below:



As the data from each bar is shown, we talk about its meaning. For example, when the “786 million 1992” fades in, explain, “This tells us that in 1992, they thought there were 786 million hungry people in the world.” Also ask some guiding questions, such as, “Why would they wait until 1992 to make the measurement for 1990?” This helps students realize that it takes time to process and compile the data.

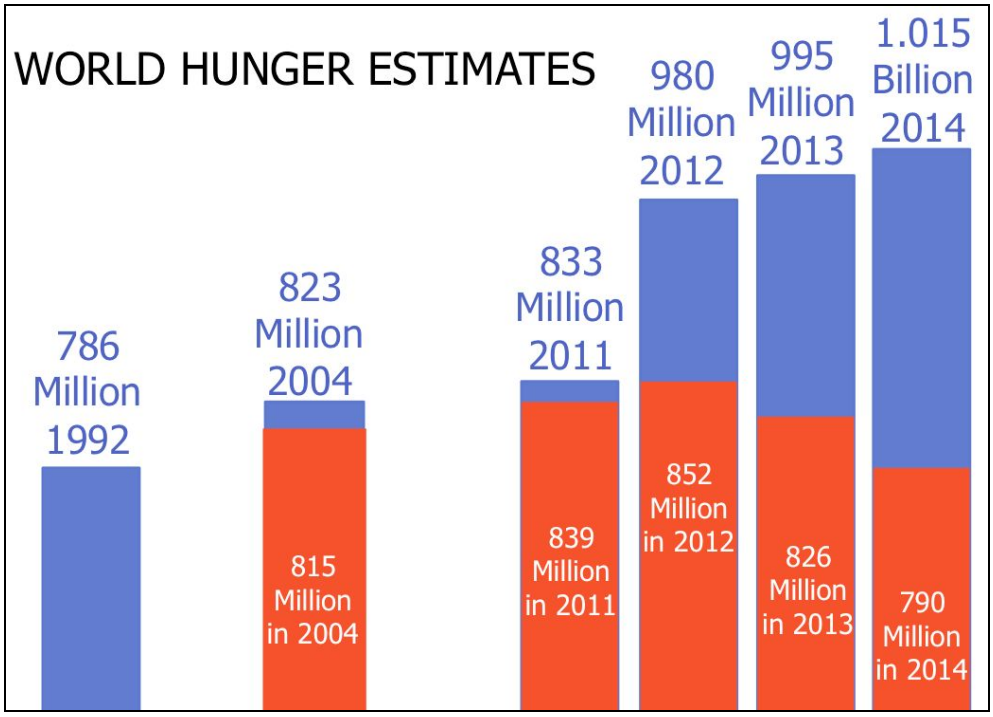
Once all the data is on the graph, talk about how this fits in with their earlier observations and questions.

Ask, “Each of these measurements represent the number of people hungry in the world in 1990. Did the different measurements give close results?”

After talking about some of the closer and some of the more dramatic examples, ask the fundamental question, “Why do you think the results might fluctuate so much?”

Explain that there is great difficulty in measuring the number of hungry people. There is one technique that relies on measuring the amount of food available to a population and another that looks at food pantries and charities. Another approach uses the survey we introduced in class. Our goal here would be to identify the challenges and limits of each approach. For example, you might find out the amount of food available to a population, but that doesn’t tell you how the food was distributed to the population. You might get some great data from food pantries and charities, but that will be only anecdotal. The survey might be the best approach, but there are challenges in interpretation of each question and challenges in finding accurate sample groups.

Finally, add in the last layer of complexity, to show the progression since 1990.



Ask, “Do you think the number of hungry people has decreased since 1990 or increased?” Students will identify that there is a difference in just going up because population has gone up and going up proportionally. Give them analogies to help. For example, if 15 out of 100 people were hungry in 1990 and the same group was surveyed today, then you might find that there

are now 20 hungry people. If the 100 people has doubled to 200 and still only 20 people are hungry, then the percent of hungry people has actually decreased.

Now that students are familiar with the data and the trends in world hunger, introduce the United Nations resolution of “halving the proportion of people who suffer from hunger.” Explain that they will now analyze the progress of the United Nations resolution and see how far it has come in this goal and how much farther it needs to go.”

Class activity
Pass out the Counting the Hungry Worksheet and give the students about 20 minutes to complete it. They may work in pairs or alone. During this part of class, circulate and facilitate partner work around the wide variety of questions. Once students are finished, go over the worksheet as a class, and clarify any misconceptions.

Using the news literacy guiding question to deepen knowledge
To wrap up their work and connect their mathematical practice to the world of digital media, ask students to brainstorm what digital resources might help them determine the number of hungry people in their own city or state.

Ask, “What resources and sources of information did we use for this lesson? Would these same resources give information about our own community and state? If not, what resources could we look for online that might help us find more local information?”

Then, instruct students to use the Internet to create a list of resources for researching hunger in both their city and state. Remember that the guiding news literacy question is, “What challenges and opportunities do the Internet and digital media create?” One answer to this question is that the Internet provides unlimited information at our fingertips, but, first, the best sources for that information must be found. Write and review these news literacy source questions on the board and explain how they are meant to help pinpoint better/accurate sources online. As students research, they should ask themselves these questions:

- *Can I tell who the source of this information is? How? Why does that matter?* Government, including state and federal websites, is often more reliable than others because they are considered independent. In other words, a private person or company isn’t paying to have only some types of information put online.
- *Can I tell how recent this information is? How?* Information that is not updated regularly on a website might not be reliable.

Materials: Counting the Hungry

1. Counting the Hungry Survey
2. Counting the Hungry Worksheet
3. Counting the Hungry Worksheet Teacher Guide
4. Extension Ideas
5. Further Resources

Counting the Hungry Survey

This is a sample of a survey used to determine world hunger levels. You do not have to fill it out, but read the questions. Think about how many people in your life would answer yes to any of the questions below. What about New York City? The world?

Q: During the past 12 months, was there a time when....?

1	You were worried you would run out of food because of a lack of money or other resources?	Yes	No	Not Sure	I Refuse
2	You were unable to eat healthy and nutritious food because of a lack of money or other resources?	Yes	No	Not Sure	I Refuse
3	You ate only a few kinds of foods because of a lack of money or other resources?	Yes	No	Not Sure	I Refuse
4	You had to skip a meal because there was not enough money or other resources to get food?	Yes	No	Not Sure	I Refuse
5	You ate less than you thought you should because of a lack of money or other resources?	Yes	No	Not Sure	I Refuse
6	Your household ran out of food because of a lack of money or other resources?	Yes	No	Not Sure	I Refuse
7	You were hungry but did not eat because there was not enough money or other resources for food?	Yes	No	Not Sure	I Refuse
8	You went without eating for a whole day because of a lack of money or other resources?	Yes	No	Not Sure	I Refuse

In New York City, I think that _____ out of every 100 kids are food insecure.[1]

Was your prediction greater than, less than, or equal to the actual number? What are your thoughts about this?

---

[1] Source: http://nyccah.org/learn-about-hunger/hunger-new-york-city

Counting the Hungry Worksheet

Directions: Answer the questions below using the chart and information provided. If there is a calculator icon near the question, then you may use a calculator. If not, then you are encouraged to find a way to estimate the answers without a calculator.

Part 1:
Write the 1990 estimates for world hunger in scientific notation. Remember, these estimates were redone many times after 1990, which is why all of the "year of calculation" dates are after 1990.

Year of Calculation	Number	Number in Scientific Notation
1992	786 Million	
2004	823 Million	
2011	833 Million	
2012	980 Million	
2013	995 Million	
2014	1.015 Billion	

Part 2:
How many more people were believed to be hungry in 1990 with the 2014 estimate than with the 1992 estimate? Show your calculation using scientific notation.

Part 3:
How many times more people were believed to be hungry in 1990 with the 2014 estimate than with the 1992 estimate? Show your calculation using scientific notation.

Part 4:
In 1990, the world population was about 5 billion people. Based on the 2014 measures, what percentage of the world was hungry in 1990? Use estimation to arrive at a reasonable answer.

Part 5:
Write the 2004, 2011, 2012, 2013, and 2014 World Hunger Estimates in scientific notation.

Year	Number	Number in Scientific Notation
2004		
2011		
2012		
2014		

Part 6:
The 2014 population was 7,176,023,055. What percentage of the world was hungry in 2014?

Part 7:
The UN has the goal of "halving the proportion of people who suffer from hunger" by 2015. If the projected population for 2015 is about 7.2 billion people, then how many more people need to be taken off of the hunger list to meet their goal? Use estimation to find a reasonable answer.

Worksheet Teacher Guide

For the first question, students are simply converting each number from standard form to scientific notation.

Part 1:
Write the 1990 estimates for world hunger in scientific notation. Remember, these estimates were redone many times after 1990, which is why all the "year of calculation" dates are after 1990.

Year of Calculation	Number	Number in Scientific Notation
1992	786 Million	
2004	823 Million	
2011	833 Million	
2012	980 Million	
2013	995 Million	
2014	1.015 Billion	

A challenge for students is to recognize that 786 million = 786 x 1,000,000 and that later 1.015 billion = 1.015 x 1,000,000,000. Consider helping students by writing some numbers directly in standard form and giving a few sample answers. For example, write 786 million as 786,000,000 and then show that it would be written as 7.86e8 in scientific notation.

The second question, asks students to identify the difference between two numbers using scientific notation. Many students confuse this as a division question.

Part 2:
How many more people were believed to be hungry in 1990 with the 2014 estimate than the 1992 estimate. Show your calculation using scientific notation.

As a modification, you might encourage students to find a reasonable way of estimating the difference: 1.015e9 - 7.86e8 = 1e9 - 8e8 = 1e9 - 0.8e9 = 0.2e9 = 2e8 or 200 million more.

The third question, asks students to recognize that this is a division question. For some students, they think it is asking them to subtract. Highlight the word "times" in the question.

Part 3:
How many times more people were believed to be hungry in 1990 with the 2014 estimate than the 1992 estimate. Show your calculation using scientific notation.

Encourage students to set up the division statement in a way that is clear and helpful.

$$\frac{1.015\times10^9}{7.86\times10^8}=\left(\frac{1.015}{7.86}\right)\times\left(\frac{10^9}{10^8}\right)$$

Encourage students to estimate *first* and *then* calculate. For example, it is known that 1.015/7.86 is about ⅛ or 0.125. The actual result is closer to 0.129, but the estimate gives a sense of accuracy from the start.

Part 4 is a multistep percentage question.

Part 4:
In 1990, the world population was about 5 billion people. Based on the 2014 measures, what percentage of the world was hungry in 1990? Use estimation to arrive at a reasonable answer.

This is a great opportunity to incorporate estimation and demonstrate how *easy* it can be to work with scientific notation in ratios, regardless of technique, they should get about 20.3%

Students might set up a number of ratios.

Part to whole.

$$\frac{1.015\times10^9}{5\times10^9}=\frac{x}{100}$$

Whole to part.

$$\frac{5\times10^9}{1.015\times10^9}=\frac{100}{x}$$

Part to Part.

$$\frac{1.015\times10^9}{x}=\frac{5\times10^9}{100}$$

Part to Part.

$$\frac{x}{1.015 \times 10^9} = \frac{100}{5 \times 10^9}$$

Students might take the more advanced functional approach.

$$\left(\frac{1.015 \times 10^9}{5 \times 10^9}\right) \times 100 = x$$

Of course, this is directly connected to the above proportions, but students might not recognize that. It is a good opportunity to connect different algorithms.

For students not comfortable with these approaches, it might help to set up a ratio table.

Part	Whole
1.015e9	5e9
	100

By adding in a few more rows and some sample values, students might be able to quickly find the missing part here.

Part 5 is a repeat of Part 1 except now students need to write the numbers in standard form and scientific notation. A simple but helpful modification might be to write in some of these values.

Part 5:
Write the 2004, 2011, 2012, 2013 and 2014 World Hunger Estimates in scientific notation.

Year	Number	Number in Scientific Notation
2004		
2011		
2012		
2014		

Part 6 is another percentage question. Students might use very similar strategies to Part 4,

including proportions, functions, and ratio tables.

Part 6:
The 2014 population was 7,176,023,055. What percentage of the world was hungry in 2014?

This question is a great opportunity for using a calculator to deal with large numbers. Not only can they enter the numbers using a mix of scientific notation (for the hungry population) and standard form (for the population, where scientific notation wouldn't help in the calculation), but also then they would have to read their answer using e notation because (7.9e8)/7176023055 is about 1.1e-1, or 11%.

Part 7 is a difficult question, but students can use their answers from Part 4 and Part 6 to think about their answer.

Part 7:
The UN has the goal by 2015 of "halving the proportion of people who suffer from hunger." If the projected population for 2015 is about 7.2 billion people, then how many more people need to be taken off the hunger list to meet their goal? Use estimation to find a reasonable answer.

Students need to first recognize that they are halving the percent from 1990, which they found in Part 4. As a modification, change the question to ask them, "How many more people need to be taken off of the hunger list to meet their goal of 10.15%?" Of course, this could be rounded to 10% to encourage their number sense. For each student, it is important to recognize that their answer should be very close to 10% of 7.2e9, or 720 million.

Next, students need to set up a proportion, function, or ratio table to find the number that is 10.15% of 7.2 billion. Then they need to find the difference between this number and the number of people currently hungry, 790 million people. Each student should find that about 70 million more people need to get off of the list.

This number might seem small, but remind them that the number is about a third of the entire United States population.

Extension Ideas

The worksheet offers a nice extension opportunity to tie in the article on which this lesson is based.

Option 1: Read the article “Counting the Hungry,” linked below, and then read the opinion response from Pietro Gennari, also linked below. Why is Gennari defensive in his response? What does the article imply? What are your thoughts?

The New York Times article “Counting the Hungry” (http://www.nytimes.com/2014/09/28/opinion/sunday/counting-the-hungry.html?smid=pl-share) is making the point that fluctuating measures in the 1990 data bring the United Nations closer to its goal of reducing the proportion of hungry people in half. In other words, as they increase the number of people believed to be hungry in 1990, the current numbers of hungry people are then relatively lower and are perceived as a measure of progress. The author brings into question the whole measurement system and wonders if it is reliable.

The opinion article, (http://www.nytimes.com/2014/10/02/opinion/world-hunger-numbers-and-solutions.html?smid=pl-share) a letter submitted by someone involved in the calculation of these numbers, fires back at the author and explains the complex process of counting and the expected fluctuations that occur in data as the tools for data collection improve.

Option 2: Review the article “Counting the Hungry” and create an improved version of the graph included with the article. Explain why you think your graph is more clear than the one that appears in the article. To see the graph, visit the New York Times Website at http://nyti.ms/1sDbgn5 or ask for a printout of the graph.

Further/related resources

For an in-depth analysis of NYC Hunger:
https://nyccah.org/files/FINAL%20Hunger%20Survey%20Report%20Web%20Site.pdf

For a summary of World Hunger Around the World:
http://www.fao.org/3/a-i4030e.pdf

For a summary of the FIES data methodology:
http://www.fao.org/fileadmin/templates/ess/voh/FIES_Technical_Paper_v1.1.pdf

News Literacy Model Curriculum in Math
Grades 9/10

Lesson 1: What Luck! Probability in the News

Lesson 1

What Luck! Probability in the news

Many of us enjoy reading news stories about people who beat the odds, whether by surviving an accident, experiencing something never seen before, or even by winning the lottery. This lesson will explain how to find the probability of different events and analyze what makes an outcome probable or improbable. This lesson walks students through basic probability calculations and culminates with an application of the math processes via a news article. This lesson has two parts. The first builds knowledge of the equations and circumstances related to probability. The second applies this knowledge to common news events that assume readers understand concepts of probability. A culminating discussion asks students to reflect on how understanding probability makes them better news consumers.

Grade Level: 9-10
Required Time: 90-120 minutes

Learning Objectives
Students will:

- Calculate the probabilities of dependent and independent events.
- Explain the likelihood of an event occurring based on its probability.
- Reflect on how understanding probability concepts affects their ability to consume and understand news.

Guiding News Literacy Question: How can students know what to believe?
News articles and content on ever-popular shareable news sites, such as BuzzFeed, are often ripe with overstatement or claims of grandiose fact. Sometimes, these claims generate fear or misunderstanding because readers do not understand the likelihood of an event actually happening. By understanding the relatively simple math calculations behind these kinds of generalizations, young adults can be more critical of which media are accurate.

Common Core State Standards

S-CP.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
S-CP.2	Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the

	product of their probabilities, and use this characterization to determine if they are independent.
Standards of Mathematical Practice 1	Make sense of problems and persevere in solving them.
Standards of Mathematical Practice 2	Reason abstractly and quantitatively.
Standards of Mathematical Practice 4	Model with mathematics.

Materials and Preparation

Internet access (or print copies of articles for activities)
PowerPoint: Verifying Probability in the News
Class set: Investigation Worksheet — Calculating the Probability of Winning the Lottery
Group Activity No. 1: Probability in the News worksheet
Group Activity No. 1: Probability in the News answer key
Group Activity No. 2: Probability of Random Events worksheet
Group Activity No. 2: Probability of Random Events answer key
Exit Ticket

Teacher Note: This lesson is split into two major parts. The first part introduces concepts of probability. The second applies these concepts to news stories and asks students to evaluate given information. Depending on the skill level of students, teachers might reduce or add time to each part accordingly.

Websites and Resources

Reporters (one from *The Olympian* newspaper) interview Powerball winner (news gathering/reporting in action)
https://www.youtube.com/watch?v=bEtXPhGMZE4

Article from *The Olympian* on Powerball jackpot winner
http://www.theolympian.com/news/local/article26093572.html

Article from NBC News on Powerball jackpot winner
http://www.nbcnews.com/news/us-news/beginners-luck-first-time-powerball-player-wins-90-million-n262126

Real-World Application – The Probability of Random Events
http://www.lightningsafety.noaa.gov/odds.shtml
http://www.struckbylightning.org/stats2014.cfm

http://www.census.gov/popest/data/state/totals/2014/index.html

Group Activity Sources

http://www.forbes.com/sites/geoffreykabat/2013/05/29/why-do-some-people-live-to-100-years/
http://www.dailymail.co.uk/news/article-2249686/Super-centenarians-Number-living-105-doubles-years-640-reaching-grand-old-age.html
http://www.pressandguide.com/articles/2014/12/30//news/doc549abda5b7a59927690792.txt
http://www.census.gov/population/projections/data/state/st_yr11to15.html
http://www.rita.dot.gov/bts/press_releases/bts016_13
http://www.ntsb.gov/investigations/data/Pages/2012%20Aviation%20Accidents%20Summary.aspx
http://www.transtats.bts.gov/Data_Elements.aspx?Data=1
http://www.abta.org/about-us/news/brain-tumor-statistics/
http://www.everydayhealth.com/brain-tumor/brain-tumor-survival.aspx
http://www.cbtrus.org/factsheet/factsheet.html

Instructional Plan

PART I: UNDERSTANDING PROBABILITY

Do Now Class Brainstorm (10 minutes)

Ask students to brainstorm the following questions:
Why are stories about people beating the odds considered newsworthy? Why do you think a story about an improbable event occurring captures the interest of the reader/viewer? Do you personally know of anyone who beat their odds?

Alternate Do Now: Give some examples of news stories where a person, or group of people, has "beaten the odds." What specific odds have the newsmakers overcome?

Possible answers:

- someone winning the lottery – the odds of winning the lottery are in the millions
- someone surviving an accident – the odds of surviving a severe accident are considered improbable
- someone finding a long lost sibling/relative – with approximately 320 million Americans, the odds of encountering a specific person is about 320 million to 1
- someone beating a life-threatening illness/disease – because people afflicted with a serious illness or disease (i.e. cancer) are expected to expire, their chances of surviving are considered unlikely

Warm-Up/Discussion – Probability Review (15 minutes)

Explain to students that **Probability** is the measure of the chance or likelihood of an event occurring.

To calculate the probability of an event, divide the number of events that you want to happen by the total number of possibilities, as shown by the ratio:

$$P_{(Event)} = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$$

Probability can be represented by a fraction, decimal, or percent. Mathematicians often use several tools to illustrate simple probability. Examples include flipping a two-sided coin, rolling a die (a fair die is a six-sided number cube that is not weighted toward any number), or drawing (choosing) a card randomly from a deck of 52 cards.

Class example (work out on board with class)
What is the probability of rolling a 6 on a die?

$$P_{(Event)} = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = P_{(6)} = \frac{1}{6}$$

Because there is one 6 on a six-sided die, the probability of rolling the 6 is $\frac{1}{6}$. It can also be said that there is a one in six chance of rolling the 6. To represent the probability as a decimal, divide the 1 by 6 for a $0.1\overline{6}$ probability. As a percent, the probability is about 16.7%.

Partner practice 1
Ask students to calculate this question: What is the probability of rolling an even number on a die? Write your answer as a fraction, decimal, and percent.

$P_{(Even)} = \frac{3}{6} = \frac{1}{2}$, 0.5, 50%

Explain that if there is more than one favorable outcome, then this will be identified by the word “or.” This situation calls for the probabilities of each outcome to be added together. For example, ask: What is the probability of rolling a 5 *or* a 6 on a number cube?

The answer is the sum of the probabilities $\frac{1}{6}$ and $\frac{1}{6}$. So, the probability of rolling a 5 or 6 is $\frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$.

Partner practice 2
Ask students to practice their calculations with the new question: What is the probability of rolling a 1 or 3 or 5 or 6 on a die?

$P_{(1 \text{ or } 3 \text{ or } 5 \text{ or } 6)} = \frac{4}{6} = \frac{2}{3}$, $0.\overline{6}$, 66.7%

Explain that the above situations are examples of the probabilities of one event. When calculating the probability of more than one event, find the probability of each event and multiply them together. If there is more than one event, this will be identified by the word “and.”

For the following examples, use:
a bag containing 6 red marbles, 3 black marbles, 1 blue marble and 4 pink marbles.

Class example
Explore the following question and calculation as a class using a whiteboard: What is the probability of randomly choosing a red marble, putting it back, *and* then choosing a pink marble?

$$P_{(red,pink)} = \frac{6}{14} \times \frac{4}{14} = \frac{24}{196} = \frac{6}{49}$$

First, find the probability of choosing a red marble. Then, find the probability of choosing a pink marble. Multiply the fractions and simplify.

Explain that in this example, there are two separate events, reaching into the bag to randomly draw a marble and then, (after putting the first marble back in the bag) reaching into the bag again and randomly drawing another marble. The product of the probabilities of both events is the chance that they will both occur.

Partner practice 3
Again in pairs, calculate this question: What is the probability of randomly choosing a blue marble, putting it back, *and* then choosing a black marble?

$P_{(blue,black)} = \frac{1}{14} \times \frac{3}{14} = \frac{3}{196}$, 0.015, 1.5%

Beyond Probability (15 minutes)
Explain that students are now going to take this lesson one step farther and explore **the Union and Intersection of Events.**

Explain that in the warm up, students saw that when they want the probability of one of two or more events to occur, they add them together. This is called the **union of events.** The union of events is represented by the ∪ symbol. In the example, the probability of rolling a 5 *or* a 6 on a die is $\frac{1}{6} + \frac{1}{6} = \frac{1}{3}$.

The union of two events can be represented by the formula:
$P(A \cup B) = P(A) + P(B)$.

Explain that in the above example, the events have no shared outcomes, so they are said to be **mutually exclusive.** (In other words, it is not possible to roll *both* a 5 *and* 6 in one roll.)

However, if the union of events has shared outcomes, then they are not mutually exclusive. (The term, *shared outcome* is also referred to as "double counting.") If the events have a shared outcome, this is called the **intersection of events.** The intersection of events is represented by the ∩ symbol. The probability of the intersection of events must be subtracted from the sum of the union. The formula for the union of events (when they are not mutually exclusive) is:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

Class example
On the whiteboard, work through the following question: What is the probability of rolling a number less than 4 or an even number on a die?

$P_{(4 \text{ or even})} = \frac{3}{6} + \frac{3}{6} - \frac{1}{6} = \frac{5}{6}$

There are three numbers less than 4 on a die.
There are three even numbers on a die.
The events have one shared outcome – number 2.

The 2 is both an even number *and* a number less than 4; therefore, it must be subtracted from the sum.

Partner exercise 4
With their partner, solve the following question: In a deck of 52 cards, what is the probability of randomly drawing an ace or a card with a heart on it? (NOTE: there are four aces and 13 hearts in a deck.)

$P_{(\text{ace or heart})} = \frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}$, 0.308, 30.8%

Independent and Dependent Events
Now, explain that students are going to take their probability skills one step further by looking at other types of events. Explain that in the Warm-Up/Discussion, they looked at

a situation where a marble was randomly chosen from a bag, then it was put back in the bag and then another marble was randomly taken out of the bag. In this scenario, the outcome of the first event had no effect whatsoever on the outcome of the second event. Because the first marble was replaced in the bag after it was chosen, there was no change in the number of total marbles in the bag for the second event. These are called **independent events** and are represented by the formula:

$P(A \cap B) = P(A) \times P(B)$.

However, if the first marble is *not* replaced, then they are now **dependent events** because the probability of one event occurring influences the likelihood of the other event. Students must account for the missing marble in the second event by subtracting one from the total number of marbles.

Class example
As a class, work through the following problem on a whiteboard.

A bag contains 6 red marbles, 3 black marbles, 1 blue marble and 4 pink marbles.
What is the probability of randomly drawing a red marble, *not putting it back,* and then choosing a black marble?

$$P_{(red,\,black)} = \frac{6}{14} \times \frac{3}{13} = \frac{18}{182} = \frac{9}{91}$$

First, find the probability of choosing a red marble. Because the red marble is kept out of the bag, there are 13 marbles left. Now, find the probability of choosing a pink marble.
Multiply the fractions and simplify.

Partner practice 5
With a partner, solve the question: What is the probability of choosing (without replacement):

A blue and then pink marble?

$$P_{(blue,\,pink)} = \frac{1}{14} \times \frac{4}{13} = \frac{4}{182} = \frac{2}{91}$$, 0.022, 2.2%

A red marble and then another red marble?

$$P_{(red,\,red)} = \frac{6}{14} \times \frac{5}{13} = \frac{30}{182} = \frac{15}{91}$$, 0.165, 16.5%

The Complement of an Event

After checking their partner-practice results for comprehension, explain to students that the opposite, or **complement,** of an event is the probability of an event *not* occurring.

For example, the probability of not rolling a 1 on a die is $P_{(\text{not } 1)} = \frac{5}{6}$ because there are five numbers on a die that are not 1. The complement of an event, A, is represented by the formula:

$P(\text{not } A) = 1 - P(A)$

Partner exercise 6:

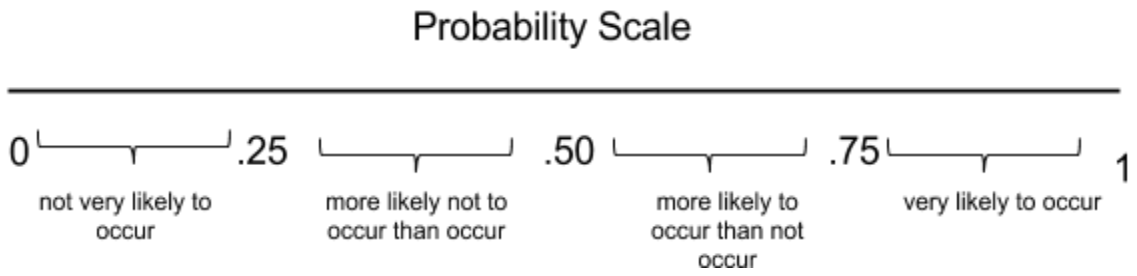
Solve in pairs: In a deck of 52 cards, what is the probability of randomly drawing a king?

$P_{(\text{not king})} = 1 - \frac{4}{52} = \frac{52}{52} - \frac{4}{52} = \frac{48}{52} = \frac{12}{13}$, 0.923, 92.3%

The Likelihood of an Event to Occur

After checking for comprehension on exercise six, explain that probability is measured on a scale from 0 to 1 (or 0 to 100%). If the probability of an event occurring is 0, then the desired outcome will never occur. If the probability is 1 (or 100%) then the outcome is certain to occur every time.

In between the scale of 0 to 1, the probability of an outcome to occur is less likely as you approach 0. As the probability approaches 1, it becomes more likely (or probable) that the favorable outcome will occur. If the probability is 0.5 (or ½ or 50%), the outcome is as likely to occur as it is not to occur.



Break for part 1 assessment (in-class or homework)
At this point in the lesson, you can assign students to pairs or groups and use the Investigation Exercise worksheet (located in the materials section) to solidify knowledge and allow them to apply the lessons they've learned thus far. Once they've demonstrated mastery of probability concepts, move on to PART II of this lesson below.

PART II: USING PROBABILITY TO UNDERSTAND THE NEWS
Building background and Applying the Guiding News Literacy Question
Ask students how often they see stories that include probability in the news? What kinds of stories might include numbers related to probability? Why is it important to understand if those numbers or true? How does it help you as a news consumer to understand how probability works and is calculated?

Explain that these are all questions related to news literacy, or the ability of citizens to think critically and engage with the news media that they consume. When you are able to critique the news and evaluate whether it is accurate, you'll be better able to use the information presented in your own life.

Explain that one of the key tenets of news literacy is the ability to verify information presented. When stories focus on math equations or concepts like probability, the simple act of applying math skills can help you become a better news consumer because it gives you the confidence to know what to believe.

Group News Activities
Divide students into groups, and explain that they are going to do two activities that allow them to apply their math skills to news stories to verify or understand information. Once the group activity is complete, they'll reflect on the process.

Pass out the two Group News Activity worksheets included in the materials section (the answer keys are also provided). Groups will likely need most of the class time to complete these activities. Based on your resources, you can either pass out copies of the relevant news stories or allow students to access them online.

Concluding discussion

After students have completed the two activities, you should have a class discussion on how this process changed their perception of the news stories or topics involved. For example, does calculating the real probability of getting hit by lightening change your response to stories about this topic? Why or why not? Do you feel like you'll be a more critical, careful reader when it comes to consuming these kinds of news stories in the future?

Ask students how understanding probability also helps them to understand why these stories made the news in the first place. When we see news stories of people who have "beaten the odds" or "done the improbable," we know that behind those statements are probabilities that can be calculated to verify those claims. Sometimes the very low probability of an outcome is news itself.

When calculating the probability of a favorable outcome, the closer the probability comes to zero, the more improbable the outcome will be achieved. Examples such as playing the lottery, getting struck by lightning, or reaching 105 years of age are all highly improbable due to their very low probabilities, which is why these outcomes are newsworthy. As the probability moves closer to one, the more likely the event will occur, such as rolling a number above 2 on a die.

Exit Ticket Assessment

You can follow up part two with an exit ticket assessment, also found in the materials section. This exercise asks students to create their own lottery game, and also reflect on whether the outcome would be newsworthy.

Materials: Probability in the News

1. Investigation Exercise and Worksheet
2. Investigation Answer Key
3. Group News Activity #1 Worksheet
4. Group News Activity #1 Answer Key
5. Group News Activity #2 Worksheet
6. Group News Activity #2 Answer Key
7. Exit Ticket Activity
8. Extension Activity
9. Extension Activity Answer Key

Investigation – Calculating the Probability of Winning the Lottery

Follow the story and predict your odds of winning!

Stories about people winning lottery jackpots are often newsworthy not only for the huge sums of money that are awarded, but because the winners have achieved an outcome that was very highly unlikely to occur. This is often described as “beating the odds.”

In state and multi-state lotteries, customers play to win a large jackpot by choosing a certain number of winning numbers from a given set of eligible numbers. Each number is printed on a ball, and the balls are randomly selected by a machine. Once a ball is chosen, it is not replaced in the machine. The order that the numbers are selected does not matter for the contest. For example, in the New Jersey Pick-6 State Lotto, customers choose six numbers out of the numbers 1 through 49. The jackpot is awarded when all six numbers are selected by the ball machine. (Smaller prizes are awarded when three, four, or five numbers are selected.)

Let’s start with a simple lottery game. In this game, you choose three numbers from a card of the numbers 1 through 10.

What types of events are characterized by the lottery game? *(Write answer below)*

.

What is the probability of getting one of your three numbers selected by the machine? Write your answer as a fraction, decimal, and percent. *(Write answer below)*

Would you say that this outcome is likely to occur? Explain your answer.

After the first number is chosen, what is the probability that the machine selects a second number that matches one of the numbers on your card?

What is the probability of getting all three numbers selected to win the jackpot?

Based on the probability that you determined, we can say that a person has a “1 in ____ chance of winning the jackpot.”

How would you describe the likelihood of this outcome occurring?

Now, calculate the probability of winning the jackpot from the New Jersey Pick-6 Lotto described above. Write the answer as a fraction.

Based on the probability that you determined, we can say that a person has a “1 in ____ chance of winning the jackpot.”

Investigation – Calculating the Probability of Winning the Lottery
(ANSWER KEY)

Stories about people winning lottery jackpots are often newsworthy not only for the huge sums of money that are awarded, but because the winners have achieved an outcome that was very highly unlikely to occur. This is often described as "beating the odds."

In state and multi-state lotteries, customers play to win a large jackpot by choosing a certain number of winning numbers from a given set of eligible numbers. Each number is printed on a ball, and the balls are randomly selected by a machine. Once a ball is chosen, it is not replaced in the machine. The order that the numbers are selected does not matter for the contest. For example, in the New Jersey Pick-6 State Lotto, customers choose six numbers out of the numbers 1 through 49. The jackpot is awarded when all six numbers are selected by the ball machine. (Smaller prizes are awarded when three, four, or five numbers are selected.)

Let's start with a simple lottery game. In this game, you choose three numbers from a card of the numbers 1 through 10.

What types of events are characterized by the lottery game?
The game involves dependent events since the balls are not replaced in the machine.
The outcomes are mutually exclusive since there cannot be any shared outcomes.

What is the probability of getting one of your three numbers selected by the machine? Write your answer as a fraction, decimal, and percent.

$\frac{3}{10}$, 0.3, 30%

Would you say that this outcome is likely to occur? Explain your answer.
This outcome is more likely to not occur than it is to occur.

After the first number is chosen, what is the probability that the machine selects a second number that matches one of the numbers on your card?

$\frac{3}{10} \times \frac{2}{9} = \frac{6}{90} = \frac{2}{45}$, 0.044, 4.4%

What is the probability of getting all three numbers selected to win the jackpot?

$\frac{3}{10} \times \frac{2}{9} \times \frac{1}{8} = \frac{6}{720} = \frac{1}{120}$, 0.008, 0.8%

Based on the probability that you determined, we can say that a person has a "1 in ____ chance of winning the jackpot." 120

How would you describe the likelihood of this outcome occurring?
This outcome is highly unlikely.

Now, calculate the probability of winning the jackpot from the New Jersey Pick-6 Lotto described above. Write the answer as a fraction.

$$\frac{6}{49} \times \frac{5}{48} \times \frac{4}{47} \times \frac{3}{46} \times \frac{2}{45} \times \frac{1}{44} =$$

$$\frac{720}{10,068,347,520} = \frac{1}{13,983,816}$$ (or $7.151123842e^{-8}$)

Based on the probability that you determined, we can say that a person has a "1 in ____ chance of winning the jackpot."
13,983,816 (or "about a 1 in 14 million chance")

Group Activity #1 Worksheet – Probability in the News

Read the articles below from NBC News and *The Olympian* newspaper in Olympia, WA, about a Washington State woman who won the PowerBall jackpot on her first try. Then answer the questions that follow.

1. http://www.theolympian.com/news/local/article26093572.html

2.http://www.nbcnews.com/news/us-news/beginners-luck-first-time-powerball-player-wins-90-million-n262126

1) Why do you think this story gained both local and national attention?

2) Lisa Quam won the $90 million jackpot, but if she decides to take the prize in 30 annual payments, how much money will she receive each year?

If she decides to take the jackpot in one lump sum, she will receive $56.8 million, according to the articles. What percentage of the money will she lose if she decides to take her prize all at once?

3) The news articles state that Lisa Quam had a “one in 175 million chance” of winning the jackpot. Is this correct?

NOTE: In the Powerball contest, a customer chooses five numbers from a set of numbers from 1 to 59. The customer must then choose a sixth number (called the Powerball) from the second set of numbers 1 through 35. (The number chosen from the second set of Powerballs may be the same as one of the numbers from the first set of numbers.)

4) How would you describe your chances of winning the Powerball jackpot? Explain your answer.

5) Based on your answer to question 4, explain whether you think the media exaggerates or underestimates the average person's chance of winning the lottery.

6) Below is a clip from the news conference announcing the winning jackpot. In the clip, a reporter from The Olympian is interviewing the Quams. What questions would you ask the couple?

https://www.youtube.com/watch?v=bEtXPhGMZE4

Group Activity #1 – Probability in the News
ANSWER KEY

Read the articles below from NBC News and *The Olympian* newspaper in Olympia, WA, about a Washington State woman who won the PowerBall jackpot on her first try. Then answer the questions that follow.

http://www.theolympian.com/news/local/article26093572.html

http://www.nbcnews.com/news/us-news/beginners-luck-first-time-powerball-player-wins-90-million-n262126

1) Why do you think this story gained both local and national attention?

2) Lisa Quam won the $90 million jackpot, but if she decides to take the prize in 30 annual payments, how much money will she receive each year?
$3 million

If she decides to take the jackpot in one lump sum, she will receive $56.8 million, according to the articles. What percentage of the money will she lose if she decides to take her prize all at once?

$\frac{90,000,000 - 56,800,000}{90,000,000} =$ 36.9%

3) The news articles state that Lisa Quam had a "one in 175 million chance" of winning the jackpot. Is this correct?

NOTE: In the Powerball contest, a customer chooses five numbers from a set of numbers from 1 to 59. The customer must then choose a sixth number (called the Powerball) from the second set of numbers 1 through 35. (The number chosen from the second set of Powerballs may be the same as one of the numbers from the first set of numbers.)

$\frac{5}{59} \times \frac{4}{58} \times \frac{3}{57} \times \frac{2}{56} \times \frac{1}{55} \times \frac{1}{35} = \frac{120}{21,026,821,200} = \frac{1}{175,223,510}$

Yes, the probability is correct.

4) How would you describe your chances of winning the Powerball jackpot? Explain your answer. Answers will vary, but students should justify their response.

5) Based on your answer to question 4, explain whether you think the media exaggerates or underestimates the average person's chance of winning the lottery. Answers will vary, but students should justify their response.

6) Below is a clip from the news conference announcing the winning jackpot. In the clip, a reporter from The Olympian is interviewing the Quams. What questions would you ask the couple?

https://www.youtube.com/watch?v=bEtXPhGMZE4

Group Activity #2 Worksheet — The Probability of Random Events

We often see and hear reports in the news that compare the probabilities of different events. For example, you may have read that you have more of a chance of getting struck by lightning than you do of winning the lottery. Or that you have about a one in 1 million chance of getting struck by lightning. Are these statements true?

As news consumers we must ask if such statements can be verified. Are the statements above facts or exaggerations? We can use the probability axioms that we have learned to find the probabilities of different real world events.

For example, to verify the statements above, we have to find out how many people have been struck by lightning in a given year. According to the National Oceanic and Atmospheric Administration, there was an average of 330 victims of lightning strikes per year from 2004-2013. In 2015, the U.S. population is estimated at 321 million.

So, the probability of getting struck by lightning in 2015 is $\frac{330}{321,000,000}$ or 0.00000102.

NOTE: To write this value as a fraction with 1 as the numerator, simply divide 1 by the decimal number to determine the denominator.

For our example: $1 \div 0.00000102 \approx 980,392$ or $\frac{1}{980,392}$.

We can say that you have a one in 980,392 chance of getting struck by lightning in 2015.

You can find more accurate probabilities of getting struck by lightning based on the state that you live in. For example, some states like Florida have a higher concentration of lightning strikes than other states.

1) What is the probability of getting struck by lightning in California? New York? Florida? Show your work.

State	2014 Population (Estimated)
California	38,802,500
New York	19,746,227
Florida	19,893,297

(An average of eight California residents per year were struck by lightning in the last seven years. An average of 11 New York residents per year were struck by lightning in the last seven years. An average of 34 Florida residents per year were struck by lightning in the last seven years.)

2) What is the probability of someone born in 2015 getting struck by lightning in their lifetime? (Assume the person lives to 85 years old and the median population of the time period is 398 million people.) Show your work.

Group Activity #2 — The Probability of Random Events
ANSWER KEY

We often see and hear reports in the news that compare the probabilities of different events. For example, you may have read that you have more of a chance of getting struck by lightning than you do of winning the lottery. Or that you have about a one in 1 million chance of getting struck by lightning. Are these statements true?

As news consumers we must ask if such statements can be verified. Are the statements above facts or exaggerations? We can use the probability axioms that we have learned to find the probabilities of different real world events.

For example, to verify the statements above, we have to find out how many people have been struck by lightning in a given year. According to the National Oceanic and Atmospheric Administration, there was an average of 330 victims of lightning strikes per year from 2004-2013. In 2015, the U.S. population is estimated at 321 million. So, the probability of getting struck by lightning in 2015 is $\frac{330}{321,000,000}$ or 0.00000102.

NOTE: To write this value as a fraction with 1 as the numerator, simply divide 1 by the decimal number to determine the denominator. For our example:

$1 \div 0.00000102 \approx 980,392$ or $\frac{1}{980,392}$.

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(An average of eight California residents per year were struck by lightning in the last seven years. An average of 11 New York residents per year were struck by lightning in the last seven years. An average of 34 Florida residents per year were struck by lightning in the last seven years.)

California = $\frac{8}{38,802,500} = \frac{2}{9,700,625} \sim \frac{1}{4,850,313}$

New York = $\frac{11}{19,746,227} \sim \frac{1}{1,795,112}$

Florida = $\frac{34}{19,893,297} \sim \frac{1}{585,097}$

2) What is the probability of someone born in 2015 getting struck by lightning in their lifetime? (Assume the person lives to 85 years old and the median population of the time period is 398 million people.)

$\frac{330 \times 85}{398,000,000} = \frac{28,050}{398,000,000} \sim \frac{1}{14,189}$

Exit Ticket – Probability

Your task is to make up your own lottery game. You will decide how many numbers a player can choose from and how many he or she must match correctly to win the jackpot. (Your lottery game must have at least 25 numbers to choose from.)

Name your lottery game, and decide how much the minimum jackpot will be and how many times per week the game is played.

Once you finish your lottery game, you will calculate the probability of winning the jackpot. Also calculate the odds of winning the jackpot if a person buys one ticket for a year each time that the game is played.

Then explain whether you think, based on the odds, the winner of this lottery would make for a worthwhile news story.

Example for a game that has 25 numbers with four needed to win the jackpot:

$$\frac{4}{25} \times \frac{3}{24} \times \frac{2}{23} \times \frac{1}{22} = \frac{24}{303{,}600} = \frac{1}{12{,}650}$$

The lottery uses dependent events.
BONUS: If the game is played twice per week:
12,650 ÷ (52 × 2) ≈ 122 years

Extension Activities: Verifying Probability in the News
Worksheet

(Note: this activity can be used with the PowerPoint that accompanies the lesson).

Have students sit in groups or work with a partner. Explain that they will read news articles of different people who have all "beaten the odds." Their task is to find the probability of each event and then explain whether they think each favorable outcome was highly improbable.

A. Beating the odds: Living forever

News organizations often report on people living past the age of 100. (They also report on advice we can use to live past 100 years.) How unlikely is it to live past 100 years? These articles explore that question. Read each, and then answer the questions below.

- http://www.forbes.com/sites/geoffreykabat/2013/05/29/why-do-some-people-live-to-100-years/
- http://www.dailymail.co.uk/news/article-2249686/Super-centenarians-Number-living-105-doubles-years-640-reaching-grand-old-age.html
- http://www.pressandguide.com/articles/2014/12/30//news/doc549abda5b7a59927690792.txt
- http://www.census.gov/population/projections/data/state/st_yr11to15.html

1. What are the odds of living past 100 years in the U.S.?
(According to the U.S. Census, 53,364 people lived past 100 years in 2010, when the population was 308,700,000.)

2. Do you think it's improbable to live past 100 years?

3. Women make up 82.8% of people living past 100 years, and men make up just 17.2% of individuals living past 100 years.

   What is the probability of a woman living past 100 years?

   What is the probability of a man living past 100 years?

4. According to a 2012 United Kingdom *Daily Mail* article, 640 Britons have reached 105 years old. The population was estimated at 63,700,000 people. What is the probability of a resident of the country reaching his or her 105th birthday?

Beating the odds: Surviving disaster

Headlines of plane crashes immediately grab the attention of the public due to many factors including our fears of flying, the rarity of aviation disasters, and the unlikeliness of surviving a crash.

From 2011– 2013, there was an average of 1,462 private and commercial airline accidents. There was an average of 454 deaths in those accidents, according to the United States Department of Transportation and National Transportation Safety Board (NTSB). The following articles explore this topic. Read each, then answer the questions below.

- http://www.rita.dot.gov/bts/press_releases/bts016_13
- http://www.ntsb.gov/investigations/data/Pages/2012%20Aviation%20Accidents%20Summary.aspx
- http://www.transtats.bts.gov/Data_Elements.aspx?Data=1

1. If there are approximately 27,000 departures *per day* in the U.S, what is the probability that one of those flights will be involved in an accident?

2. If there were an average of 813,353,472 airline passengers in the U.S., what is the probability that someone will be involved in a fatal crash?

3. What are your thoughts on the above probabilities?

Most airplane accidents that occur are small private (personal) planes and instructional planes. Here are the figures for *only* commercial and commuter passenger airlines:
Average number of accidents: 75
Average number of flights: 9,662,667
Average number of fatalities: 31
Average number of passengers: 734,000,000

4. What are the probabilities of being involved in an accident?
In a fatality?

5. Do these new probabilities change your perception of the risks of air travel? Explain your answer.

Beating the odds: Surviving disease

News reports about people struggling to beat the odds can also be heartwarming. For example, stories about patients given only months to live who end up surviving their illnesses or diseases to go on living happy and productive lives are newsworthy because the outcome was unexpected. Some afflictions, such as cancer, have lower survival rates than other illnesses (such as pneumonia, for example) so the probability of survival is lower. Also, the more a disease or illness progresses, the lower the chances of surviving.

Let's take the example of a brain tumor, which immediately generates headlines by survivors due to its difficulty to overcome. There are approximately 343,000 patients living with brain or spinal cord tumors in the U.S. Every year, about 14,000 people die from the cancer. The following stories explore this issue. Read each, and then answer the questions below.

- http://www.abta.org/about-us/news/brain-tumor-statistics/
- http://www.everydayhealth.com/brain-tumor/brain-tumor-survival.aspx
- http://www.cbtrus.org/factsheet/factsheet.html

1) What is the probability of surviving a brain or spinal cord tumor? Use the complement of an event to calculate your answer.

2) The probability of surviving a brain tumor decreases if the cancer is not cured. The probability of surviving a brain tumor for 5 years is about $\frac{1}{3}$. How many people living with the disease will survive after five years?

3) If there are 68,000 new cases of brain tumors each year, what is the probability that someone will become afflicted in 2015? In 2015, the U.S. population is estimated at 321 million.

Extension Activities: Verifying Probability in the News
ANSWER KEY

(Note: this activity can be used with the PowerPoint that accompanies the lesson).

Have students sit in groups or work with a partner. Explain that they will read news articles of different people who have all "beaten the odds." Their task is to find the probability of each event and then explain whether they think each favorable outcome was highly improbable.

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- http://www.dailymail.co.uk/news/article-2249686/Super-centenarians-Number-living-105-doubles-years-640-reaching-grand-old-age.html
- http://www.pressandguide.com/articles/2014/12/30//news/doc549abda5b7a59927690792.txt
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1. What are the odds of living past 100 years in the U.S.?
(According to the U.S. Census, 53,364 people lived past 100 years in 2010, when the population was 308,700,000)

$$\frac{53,364}{308,700,000} \approx \frac{1}{5,785} \approx 0.00017287$$

2. Do you think it's improbable to live past 100 years?

3. Women make up 82.8% of people living past 100 years and men make up just 17.2% of individuals living past 100 years.

What is the probability of a woman living past 100 years?

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$$\frac{640}{63{,}700{,}000} \approx \frac{1}{99{,}532} \approx 0.00001$$

Beating the odds: Surviving disaster

Headlines of plane crashes immediately grab the attention of the public due to many factors including our fears of flying, the rarity of aviation disasters, and the unlikeliness of surviving a crash.

From 2011– 2013, there was an average of 1,462 private and commercial airline accidents. There was an average of 454 deaths in those accidents, according to the United States Department of Transportation and National Transportation Safety Board (NTSB). The following articles explore this topic. Read each, then answer the questions below.

- http://www.rita.dot.gov/bts/press_releases/bts016_13
- http://www.ntsb.gov/investigations/data/Pages/2012%20Aviation%20Accidents%20Summary.aspx
- http://www.transtats.bts.gov/Data_Elements.aspx?Data=1

1. If there are approximately 27,000 departures *per day* in the U.S, what is the probability that one of those flights will be involved in an accident?

$$\frac{1{,}462}{27{,}000 \times 365} \approx \frac{1}{6{,}740}$$

2. If there was an average of 813,353,472 airline passengers in the U.S., what is the probability that someone will be involved in a fatal crash?

$$\frac{454}{813{,}353{,}472} \approx \frac{1}{1{,}791{,}527}$$

3. What are your thoughts on the above probabilities?

Most airplane accidents that occur are small private (personal) planes and instructional planes. Here are the figures for *only* commercial and commuter passenger airlines:
Average number of accidents: 75
Average number of flights: 9,662,667
Average number of fatalities: 31
Average number of passengers: 734,000,000

4. What are the probabilities of being involved in an accident? In a fatality?

$$P_{(\text{accident})} = \frac{75}{9{,}662{,}667} \approx \frac{1}{128{,}836}$$

$$P_{(\text{fatality})} = \frac{31}{734{,}000{,}000} \approx \frac{1}{23{,}677{,}421}$$

5. Do these new probabilities change your perception of the risks of air travel? Explain your answer.

Beating the odds: Surviving disease

News reports about people struggling to beat the odds can also be heartwarming. For example, stories about patients given only months to live who end up surviving their illnesses or diseases to go on living happy and productive lives are newsworthy because the outcome was unexpected. Some afflictions, such as cancer, have lower survival rates than other illnesses (such as pneumonia, for example) so the probability of survival is lower. Also, the more a disease or illness progresses, the lower the chances of surviving.

Let's take the example of a brain tumor, which immediately generates headlines by survivors due to its difficulty to overcome. There are approximately 343,000 patients living with brain or spinal cord tumors in the U.S. Every year, about 14,000 people die from the cancer. The following stories explore this issue. Read each, and then answer the questions below.

- http://www.abta.org/about-us/news/brain-tumor-statistics/
- http://www.everydayhealth.com/brain-tumor/brain-tumor-survival.aspx
- http://www.cbtrus.org/factsheet/factsheet.html

1) What is the probability of surviving a brain or spinal cord tumor? Use the complement of an event to calculate your answer.

$$P(\textit{not dying}) = \left(1 - \frac{14{,}000}{343{,}000}\right) = \frac{24}{25} = 0.96 = 96\%$$

2) The probability of surviving a brain tumor decreases if the cancer is not cured. The probability of surviving a brain tumor for 5 years is about $\frac{1}{3}$. How many people living with the disease will survive after five years?

114,333

3) If there are 68,000 new cases of brain tumors each year, what is the probability that someone will become afflicted in 2015? In 2015, the U.S. population is estimated at 321 million.

$$\frac{68{,}000}{321{,}000{,}000} \approx \frac{1}{4{,}721}$$

News Literacy Model Curriculum in Math
Grades 9/10

Lesson 2: Standard Deviation and 'Calculating' the News

Lesson 2

Standard Deviation and 'Calculating' the News

News stories commonly display statistics, using margin of error, deviation from the mean, and standard deviation to help explain variance. However, they don't always provide all the information necessary for consumers to check the math or come to their own conclusions. What's more, many readers do not understand what these statistical descriptions mean or how they really provide information and context. This lesson helps students understand common statistical terms and processes used in news stories.

Grade Level: 9-10
Required Time: 90-120 minutes

Learning Objectives
Students will:

- Calculate calculate the standard deviation of a set of data.
- Explain the reliability of a set of data using measures such as margin of error and standard deviation.
- Articulate how understanding these mathematical processes helps them to better understand statistics in the news.

Guiding News Literacy Question: How can students know what to believe?
News articles,especially those that deal with surveys or other political data, often give statistical description without helping readers to decipher what those descriptions mean. By understanding the relatively simple math calculations behind these numbers, young adults can be more critical of what media are accurate and what meaning statistics convey.

Common Core State Standards

S-ID.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
S-ID.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
S-IC.6	Evaluate reports based on data.

Standards of Mathematical Practice 1	Make sense of problems and persevere in solving them.
Standards of Mathematical Practice 2	Reason abstractly and quantitatively.
Standards of Mathematical Practice 3	Construct viable arguments and critique the reasoning of others.
Standards of Mathematical Practice 6	Attend to precision.

Materials and Preparation

PowerPoint Presentation: Statistics in the News Discussion/Warmup
PowerPoint Presentation: Understanding the Distribution of a Data Set
PowerPoint Presentation: Using Variation to Judge Statistics
Standard Deviation and Financial Literacy Worksheet (including printouts of article below or online access)

USA Today column on evaluating stocks using standard deviation
http://usatoday30.usatoday.com/money/perfi/columnist/krantz/2008-03-10-standard-deviation_N.htm

Standard Deviation and Financial Literacy Answer Key
Education and Income Worksheet (including printouts of article below or online access)

Wall Street Journal article on using data to measure the value of a college education
http://blogs.wsj.com/economics/2014/12/22/white-house-and-census-set-to-collide-over-college-education-data/?mod=WSJ_EC_RT_Blog

Education and Income Worksheet Answer Key
Exit Ticket Assessment
Exit Ticket Answer Key

Websites and Resources

http://www.ncpp.org/
http://www.decodedscience.com/polling-accuracy-in-the-presidential-election/13262/2
http://www.gallup.com/poll/9442/Election-Polls-Accuracy-Record-Presidential-Elections.aspx
http://www.pewresearch.org/2007/02/14/how-reliable-are-the-early-presidential-polls/

http://fivethirtyeight.blogs.nytimes.com/2012/11/10/which-polls-fared-best-and-worst-in-the-2012-presidential-race/?_r=0

Instructional Plan

Do Now Warm Up
Ask students: When data is displayed in graphs and charts, what are some ways that we can tell whether the data is accurate or misleading?
Possible answers: sample size, margin of error, the scales of the *x*- and *y*-axes, etc.

Alternate Do Now: Read a recent news article reporting on the results of a poll that states 43% of voters would vote for Hillary Clinton if she ran for president. The article explains that the margin of error of the poll is ±3.1%. How does the margin of error affect the results of the poll?
The margin of error reflects the confidence level of how the sample of people polled represents the population. So, if the margin of error (assuming a 95% or greater confidence level) is 3.1%, then the population of voters who support Hillary Clinton ranges from 39.9% to 46.1%.

Building Background and Discussion of the News Literacy Guiding Question
(optional PowerPoint presentation included)
Explain to students that as news consumers, we are often presented with reports of statistics that are very newsworthy. Ask: *What kinds of stories commonly use statistical data to convey information or frame meaning?*

The latest election polls, the change in financial markets, studies on the effectiveness of new medications, and new scientific discoveries are all examples of news stories that can include sets of data.

Explain to students that reporters and editors are responsible for analyzing data and presenting it to the public so that it's easy to read and understand. Still, sometimes news organizations are handed hundreds of pages of important data but only have a limited amount of space (in a newspaper or magazine) or time (for radio and TV) to present the findings. So, they'll often try to summarize data.

Ask: *What are some ways to "summarize" a set of data?*

One way to summarize a set of data is to find the central tendencies of its distribution. The mean, median, and mode are all measures of central tendency (you may want to write these numbers on the board and have students define each). For example, it is easier to write the mean, or average, of a set of data, then it is to write each data value.

The median, or “middle number,” is another example of a measure of central tendency that helps characterize a set of data.

Ask: *when we are given these different summaries, how do we determine if that information is reliable and accurate?*

We are constantly presented with different representations of statistics in the news, in advertisements, on the Internet, etc. It’s crucial as a modern society to be able to interpret the statistics that we see and hear in the media. There are several different measures that we can use to help us better understand the statistics that are presented to us, and consequentially, we’ll be better prepared to judge what kind of statistical information is accurate in a news report.

Understanding Standard Deviation (optional PowerPoint included)
Explain to students that the mean is a measure to help us understand the center of distribution of a set of data. However, the mean only shows us part of the story behind the statistics. We can also tell how far the individual data values are from the mean of the data set using other statistical measures. (We say that a data value that is not the mean, “deviates” from the mean.) Examples of these measures are the margin of error, deviation from the mean, and the standard deviation.

The margin of error is mainly used in surveys. The margin of error represents the amount of random sampling error in a survey’s results. In other words, a survey only questions a *sample* of people, not the whole *population*. The fewer number of people in the sample, the greater the margin of error. When reading the results of a survey in the media, it is important for the consumer to know that the larger the margin of error, the less confidence one should have in the survey’s results.

Activity #1
Explain that from 2013-2014, *The New York Times* published a series of articles entitled, “Paying Till It Hurts,” on the costs of health care. In one of the articles, *The Times* and CBS News conducted a random survey of 1,006 adults. In December 2014, *The Times* published the article “How the High Cost of Medical Care is Affecting Americans” based on results from the survey. The margin of error was reported as “4 percentage points in either direction” (for a 95% confidence level).

Pair students up, and instruct them to read the following articles together (either by providing a printout of the articles or providing Internet access to read online):
http://www.nytimes.com/interactive/2014/12/18/health/cost-of-health-care-poll.html

http://www.nytimes.com/2014/12/19/us/how-the-poll-was-conducted.html?_r=0

Instruct students to answer the following question in pairs (you can write the questions on the board as they are reading the articles):

1) What is another way to write the margin of error? ±4%
2) The poll asked adults, "Is the amount of time you spend dealing with insurance paperwork and health care bills a major problem for you and your family, a minor problem, or not a problem at all?"

If 16% of adults surveyed answered that it was a "major problem," what is the range for the entire population of U.S. adults that would give the same answer? 12% to 20%

After each pair has come up with their answer, ask for volunteers to report their findings to the class and explain their math. Correct and clarify as needed.

Explain that the deviation from the mean is how far one of the data points differs from the mean. If the mean is represented by $\bar{x}$ and the data value is represented by x, then the deviation from the mean is $x - \bar{x}$. For example, the mean for a set of values is 76. If one of the data values is 84, then the deviation from the mean is 84–76= 8.

Activity #2

Students should switch pairs to work with a new student for this activity to further their understanding of standard deviation.

Explain that a December 2014 article in the *Los Angeles Times* reported the results from an American Academy of Pediatrics study that surveyed 1,941 ninth- and tenth-grade students in Hawaii on their cigarette and e-cigarette use. The mean age of the students surveyed was reported as 14.6 years.

Read the following articles in pairs, and respond to the questions below (you can write them on the board as the class reads). Either print copies of the articles or provide Internet access to read online.

http://pediatrics.aappublications.org/content/early/2014/12/09/peds.2014-0760.full.pdf+html

http://www.latimes.com/science/sciencenow/la-sci-sn-e-cigarette-gateway-drug-20141215-story.html

1) If the ages of five students are 15.1 years, 14.8 years, 13.7 years, 14.2 years, and 14.6 years, what are their deviations from the mean? 0.5, 0.2, –0.9, –0.4, and 0

You might want to refresh this point as students work on the first problem: Explain that the standard deviation (represented by the Greek letter sigma, σ) is a measure that tells us how spread out the *entire* set of data points are from the mean of the same data. For example, in a set of data values that measures the heights of a sample of teenage girls, the mean is listed at 62 inches. The standard deviation of the data set will tell us if the heights of the girls sampled in the survey are clustered close the mean, or dispersed farther from the mean.

(Deviation from the mean tells us how far one data point is from the mean whereas standard deviation tells us how far spread apart the entire set of data points are from the mean.)

> Standard deviation is always a positive number. A low standard deviation indicates that the data values are very close to the mean. A high standard deviation tells us that the data values are spread out over a large range of values. A standard deviation of 0 indicates that all data points are equal to the mean.

Connecting Standard Deviation to News Media Understanding

Explain that standard deviation can tell us more about the statistics that we see in the media. In financial news stories, standard deviation can tell us how volatile the markets are (or the volatility of the prices of individual investments). (Furthermore, the higher the standard deviation, the more *risk* is associated with investing.) In opinion polls, standard deviation can tell us if there will be a large or small margin of error. (The margin of error is determined by calculating the standard deviation in the results if the same poll were to be conducted multiple times.) In news stories about new medications or results from experiments, standard deviation can give more insight into the effectiveness of the trials.

Look at this example with your students of the heights of a sample of teenage girls:

The first five girls sampled measure 54 in., 58 in., 65 in., 66 in., 67 in.
The second group measures 61 in., 61 in., 62 in., 62 in., 64 in.
A third group measures 48 in., 59 in., 66 in., 67 in., 70 in.

The mean of the first group of girls is 62 in.
The mean of the second group is also 62 in.
The mean of the third group is 62 in. as well.

However, the standard deviations of the groups are 5.7, 1.2, and 8.8. Notice how the data points in the second group are close to the mean of 62 inches, which results in a low standard deviation of 1.2. However, the data points in the first group are farther from the mean, and the values in the third group are even more spread out from the mean, thus the higher standard deviations.

To find the standard deviation of a set of data, use the formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n-1}}$$

where n = the number of data values

In other words, the standard deviation is the sum of the squared deviations from the mean for each data point, divided by one less the number of data points.

Class Example
On a whiteboard or with the accompanying PowerPoint, work through this example with the class. Ask students to write down pertinent information and do the problem on their own paper, too.

A survey conducted by the Organisation for Economic Co-operation and Development (OECD) polled 15-year-old students around the world on the number of hours they spend per week completing their homework. The results, published by *The Huffington Post* in December 2014, showed that U.S. students spent a mean of 6.0 hours per week completing their homework. (You might want to stop to read through these articles):

1. http://www.huffingtonpost.com/2014/12/17/oecd-teens-homework-_n_6334502.html
2. http://www.oecd.org/pisa/keyfindings/pisa-2012-results-volume-II.pdf

You conduct a poll of six local 15-year-olds on the number of hours they spend during the week completing their homework. Their answers are shown below:
3.5 hours, 10.25 hours, 6.33 hours, 4.25 hours, 7.0 hours, 8.75 hours
What is the standard deviation of your survey? (Use the mean of your data.)

As students walk through the separate parts of this equation, ask for volunteers to share their work and write the equations on the board.

$\bar{x} = 6.68$

$$\sigma = \sqrt{\frac{(3.5 - 6.68)^2 + (10.25 - 6.68)^2 + (6.33 - 6.68)^2 + (4.25 - 6.68)^2 + (7 - 6.68)^2 + (8.75 - 6.68)^2}{6 - 1}}$$

$$\sigma = \sqrt{\frac{(-3.18)^2 + (3.57)^2 + (-0.35)^2 + (-2.43)^2 + (0.32)^2 + (2.07)^2}{5}}$$

$$\sigma = \sqrt{\frac{(10.1124) + (12.7449) + (0.1225) + (5.9049) + (0.1024) + (4.2849)}{5}}$$

$$\sigma = \sqrt{6.6544}$$

$$\sigma = 2.58$$

Using Measures of Variation to Judge the Credibility of Statistics in the News
Use the accompanying PowerPoint to explain to students how these measures can be used to determine the credible of statistics in news articles. The slideshow walks through the main points and examples discussed below. As you discuss this idea with students, ask them when and where they've seen statistics in recent news stories.

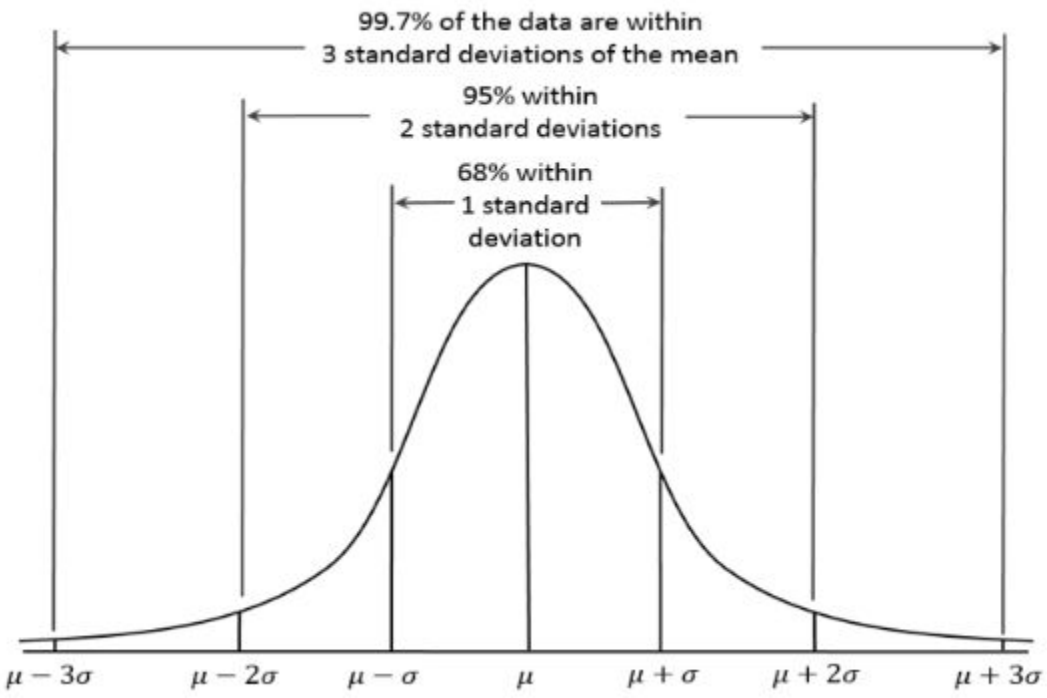
Explain that just as you can use measures like the margin of error and standard deviation to gauge your confidence in the data that you're reading, you can also use these metrics to measure your confidence in the articles or stories where the statistics are reported. Furthermore, the news media often reports on the decisions and predictions of people who are interpreting the data. These newsmakers can include politicians and lawmakers, scientists, city planners, environmentalists, community leaders, etc. If you can interpret the data, you're better able to see accuracy and even evidence of bias or objectivity in the news.

Not only do the standard deviation and margin of error show how much variation lies in the data, but they also help measure the amount of confidence that the reader has in the conclusions that are drawn by the data. To understand how this occurs, we can take a look at the shape of a normal data distribution.

A normal distribution of data occurs when the number of data points increases as you approach the mean (and therefore decreases the further from the mean.) If you were to plot the individual data points of a normal distribution on a graph, the figure of a bell-shaped curve would form. The bell curve, shown below, is symmetrical about the mean. The most frequent values are clustered around the mean, and data points with very large deviations from the mean are extremely rare and occur at the two tail ends of the curve.

In a normal distribution, the probability that a random variable will appear is greater the closer you get to the mean. The probability that a random data point will appear approaches zero as you approach either tail of the curve.

Normal distributions appear in many real-world events, from class test scores, to the heights of a population, to economics, to production, and many other situations.
In a normal distribution, 68.27% of all data values lie within one standard deviation, 95.45% lie within two standard deviations, and 99.73% lie within three standard deviations.



In most surveys and opinion polls reported in the news media, it is the standard for the results to be two standard deviations from the mean. This is referred to as “a 95% confidence level.” The more data values that lie outside of two standard deviations, then the more we should question the significance of the data. In other words, if a study or survey contains data values that are several standard deviations away from the center (or conclusion), then this is evidence that some of the data is not consistent with the overall result or the conclusions drawn by the source.

Application Activity #1—Using Statistics to Decipher the News

Explain that tables, charts, and graphs presenting statistical data are meaningful ways to tell a news story. Oftentimes, these statistics shape the decisions of both the newsmaker and the news consumer.

When a large amount of data is presented, it is often helpful to summarize the data using measures of center, such as the mean, median, and mode. However, these metrics only tell part of the story. We can also measure our confidence in the reports by looking at measures of variability – margin of error, deviation from the mean, and standard deviation.

These tools help us question the reliability, or significance, of the data from voter surveys, opinion polls, financial news, medical studies, etc. Measures of variability give individuals a better understanding of the information they receive from the news.

Break students into pairs or groups and have them complete the “Standard Deviation in Financial News” activity, located under the materials section.

Note: You will need to provide Internet access to read the articles, or provide printed handouts of the articles indicated on the worksheet.

Application Activity #2—Understanding Education and Income
Switching pairs and groups, ask students to complete the “Education and Income” worksheet activity, located under the materials section.

Note: You will need to provide Internet access to read the articles, or provide printed handouts of the articles indicated on the worksheet.

Assessment Exit Ticket
Based on how your students did with the activities, you may need to review concepts before administering the exit ticket assessment, located in the materials section.

Materials: Standard Deviation in the News

1. Standard Deviation and Financial Literacy Worksheet
2. Standard Deviation and Financial Literacy Answer Key
3. Education and Income Worksheet
4. Education and Income Worksheet Answer Key
5. Exit Ticket Assessment
6. Exit Ticket Answer Key

Standard Deviation in Financial News Activity

Directions: Read the column below online (or have the teacher provide a printed version). Then, respond to the questions below to compare the data distribution of two sets of data.

Read

1. USA Today column: http://usatoday30.usatoday.com/money/perfi/columnist/krantz/2008-03-10-standard-deviation_N.htm

Questions

1. According to the columnist, how is standard deviation used to measure risk with investments?

2. CNBC News reported on Apple and IBM stocks in October 2014:

   For six days, Apple, Inc. (AAPL) stock closed at the following prices:
   $101.02, $100.73, $98.75, $97.54, $106.74, $107.34

   For six days in the same month, IBM Corp. (IBM) stock closed at the following prices:
   $163.23, $161.79, $162.18, $162.08, $163.60, $163.46

   Calculate the standard deviation for each stock.

   Which company has the greater standard deviation? Why?

3. If you had $2,000 to invest but you could only buy shares of one of the above stocks, which stock would you purchase? Explain your answer using the data above.

Standard Deviation in Financial News Activity
ANSWER KEY

1. “A stock that tends to go up and down frequently, in large moves, would have a high standard deviation. A volatile stock is riskier because there's a greater chance of the investor facing a large loss at any given time — especially a time when the investor might need to sell the stock. By contrast, a slow-and-steady stock would be less scary, and less risky.”

2. AAPL: $\sigma = 4.1$
IBM: $\sigma = 0.79$
Apple has the greater standard deviation because there is more variability in the stock prices. The data points are further from the mean than IBM’s data values.

3. Possible answer: The IBM stock has a smaller standard deviation so it is the “safer,” more consistent stock to purchase.
Possible answer: The Apple stock has a greater standard deviation which means it is more volatile and so there is more risk involved. However, it also means that there’s more potential to earn more money.

Education and Income Activity

Directions: Read the column below online (or have the teacher provide a printed version). Then, respond to the questions below to compare the data distribution of two sets of data.

Read

1. Wall Street Journal article: http://blogs.wsj.com/economics/2014/12/22/white-house-and-census-set-to-collide-over-college-education-data/?mod=WSJ_EC_RT_Blog

Questions

1. In the American Community Survey from the Census Bureau, college majors were classified into 15 different groups. Four of the groups are Health, Law and Public Policy, Engineering, and Communications and Journalism.

The table below shows the median incomes (in thousands of dollars) for graduates earning one of the Bachelor's degrees in each group.

Health Group	Law & Public Policy Group	Engineering Group	Communications & Journalism Group
Nursing: $60K	Pre-Law & Legal Studies: $49K	Electrical Engineering: $85K	Advertising & Public Relations: $50K
Pharmaceuticals: $105K	Criminal Justice & Fire Protection: $50K	Mechanical Engineering: $80K	Journalism: $51K
Community & Public Health: $48K	Public Administration: $59K	Civil Engineering: $78K	Communications: $50K
General Medical & Health Svcs: $45K	Public Policy: $48K	Petroleum Engineering: $102K	Mass Media: $45K
Medical Technician: $58K	Court Reporting: N/A	Chemical Engineering: $86K	
Health Administration Svcs: $55K		General Engineering: $70K	
Nutrition Sciences: $46K		Architectural Engineering: $65K	

Which group has the most variation in graduates' incomes?

2. If you were to choose a major in one of the four groups above based on income, which would you choose? Explain your answer.

3. In the article, the White House, along with the Department of Education, are at odds with the Census Bureau on how to value a college education.

The Census Bureau measured the value of a college education based on the incomes of graduates of different majors. The White House, however, has released a draft "to rate schools on graduation and retention rates, the ability of graduates to pay back student loans, and whether schools include low-income and first-generation students. This initiative, run out of the Department of Education, would not rely on ACS data."

Which side – the Census Bureau or the White House – do you believe is a more accurate way to value a college education? Explain your answer.

4. You have been asked to design a survey for the White House based on its criteria to measure the value of a college education. What are some questions that you would include on your survey?

Education and Income Activity
ANSWER KEY

1. Health Group: σ = 20.9
   Engineering Group: σ = 12
   Law & Public Policy Group: σ = 5.1
   Communications & Journalism Group: σ = 2.7

   The Health Group has the greatest variability of incomes.

Answers to questions 2-3 will vary but should include explanation and support based on the data.

Exit Ticket Assessment — Reliability of Election Polls

Objective: Students will be able to calculate standard deviation and compare the data distribution of two or more sets of data.

In the period leading up to Election Day, many news organizations provide the results of polling firms that survey voters on which candidates they plan to vote for. Examples of popular polling firms include The Gallup Organization, Quinnipiac University, Google Consumer Surveys, and The Pew Research Center. News organizations such as *The Washington Post*, ABC News, and *The New York Times* also conduct their own election polls. These timely polls are considered very newsworthy, considering the data that they provide. News reports on the polls show which candidates the voting population – and segments of the population – are voting for.

Once the election has ended, polling firms calculate how far their survey numbers deviated from the actual voting results. These reports have become newsworthy themselves because they show the inaccuracies of some of the polling firms.

The table below shows how much three polling firms deviated from the actual election result for last four presidential elections (rounded to the nearest whole number).

Election Year	Gallup Error	CBS News Error	Pew Research Error
2012	5%	3%	1%
2008	4%	6%	1%
2004	3%	3%	6%
2000	2%	7%	2%

1. What are the standard deviations for the three polling firms?

2. Based on results from the last three presidential elections, which polling firm would you have the most confidence with? Explain your answer.

Exit Ticket Assessment — Reliability of Election Polls
ANSWER KEY

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2004	3%	3%	6%
2000	2%	7%	2%

1. What are the standard deviations for the three polling firms?

Gallup: $\sigma = 1.3$

CBS News: $\sigma = 2.1$

Pew Research: $\sigma = 2.4$

2. Based on results from the last three presidential elections, which polling firm would you have the most confidence with? Explain your answer. Answers will vary.

News Literacy Model Curriculum in Math
Grades 9/10

Lesson 3: Using Regression Line Model to Make Predictions

Lesson 3

Using Regression Line Model to Make Predictions

Data is used to form decisions. Sometimes we can make predictions based on the data and use those predictions to influence our decisions. Since some of these decisions impact the lives of individuals, they are reported by the news media. Examples include new traffic laws based on accidents data, immigration reform based on the number of people emigrating to the U.S., and gas prices based on the supply and demand of oil. In this lesson, students will look at a mathematical model called the regression line, or line of best fit. The regression line can be used to make predictions based on data that has a linear relationship.

Grade Level: 9-10
Required Time: 90-120 minutes

Learning Objectives

Students will:

- Make a scatter plot of bivariate data.
- Determine the regression line from a set of data.
- Use the regression line to make predictions.
- Evaluate how this process can be used in understanding news media content.

Guiding News Literacy Question: What challenges and opportunities do the Internet and digital media create?
Politicians and government officials often use data sets to make decisions or make characterizations about how policy and law is working in our country. The Internet makes these data sets easy to access but not always easy to interpret. So, learning how to use online data to understand policy and economic issues is paramount.

Common Core State Standards

S-ID.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
S-ID.6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
S-IC.6.a	Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.*

S-IC.6.c	Fit a linear function for a scatter plot that suggests a linear association.
S-ID.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
Standards of Mathematical Practice 1	Make sense of problems and persevere in solving them.
Standards of Mathematical Practice 2	Reason abstractly and quantitatively.
Standards of Mathematical Practice 3	Construct viable arguments and critique the reasoning of others.
Standards of Mathematical Practice 6	MP 6. Attend to precision.

Materials and Preparation

Internet access (or print copies of articles for activities)
PowerPoint: Scatter Plot Review
PowerPoint: Using the Regression Line to Make Predictions
Class set: Graph paper
Class set: Graphing calculators (TI-84 Plus family)
Life Expectancy Pair Activity Worksheet
Pair Activity Answer Key
Exit Ticket Assessment
Exit Ticket Answer Key
Extension Activity — Predicting Fashion Trends
Extension Activity Answer Key

Websites and Resources

Articles

1. Associated Press article on US economy
   http://news.yahoo.com/us-economy-grew-fast-5-pct-annual-rate-133649505--finance.html;_ylt=A0LEV0e5VadUWoAAo0pXNyoA;_ylu=X3oDMTEzNWJlbjg4BHNlYwNzcgRwb3MDMQRjb2xvA2JmMQR2dGlkA1ZJUDIyN18x
2. Same article (printed in Seattle Times)
   http://seattletimes.com/html/businesstechnology/2025300473_apxeconomy.html
3. CBS: Is a Country's Economy a Factor in the Life Expectancy of its Population?

http://www.cbsnews.com/news/life-expectancy-rises-in-every-region-but-one/

4.Reuters article: Rise of life expectancy
http://news.yahoo.com/global-population-living-six-years-longer-1990-study-0002
18413.html;_ylt=AwrBEiIZ4qZU3kMAPOHQtDMD

Sources

1. http://www.inflationdata.com/Inflation/Consumer_Price_Index/HistoricalCPI.aspx
?reloaded=true#Table
2. http://www.bls.gov/data/

Instructional Plan

Warm Up/ Do Now

Tell students the average Ruby-throated hummingbird flaps its wings 55 times per second. Ask: How many times does the hummingbird flap its wings after 15 seconds? After a minute? Wait for students to calculate and respond.
Answer: 825 times; 3,300 times

Ask: Can you write an equation that represents how many times, *y*, the hummingbird flaps its wings per number, *s*, of seconds? Wait for students to work and respond.
Answer*: y* = 55*s*

Discussion – Scatter Plot Review

Explain to students that it's the responsibility of the news media to report on important decisions made by newsmakers. Those decisions might include new traffic laws based on the number of accidents, immigration reform based on the number of people emigrating to the U.S., and gas prices based on the supply and demand of oil. These decisions make headlines because of the impact they have on our lives. Ask: *Why is it important for the news to report on these decisions for us?*

Note: You may want to use the accompanying "Scatter Plot Review" PowerPoint during this portion of the lesson.

Sometimes politicians, lawmakers, and other leaders make their decisions based on predictions from data they receive. They use mathematical models to make their predictions, which in turn form their decisions. *The line of best fit, or regression line, is one of those models.*

The data that we will be looking at is called bivariate data (write this term on the board). A bivariate data set consists of observations on two variables. For example, the annual average unemployment rate and the average annual consumer confidence index from 2006 to 2014 are shown in the table below (project this table or have it drawn on the board).

(According to the Bureau of Labor Statistics, persons are classified as unemployed if they do not have a job, have actively looked for work in the prior 4 weeks, and are currently available for work. Consumer confidence measures the degree of optimism that consumers feel about the overall state of the economy and their personal financial situation. If consumer confidence is high, consumers will spend more. But if confidence

is lower, consumers tend to save more and spend less. The consumer confidence index is an important economic statistic because it measures how confident people feel about their incomes which affects spending, which in turn affects the strength of the overall economy.)

Year	Unemployment Rate (%)	Consumer Confidence
2006	4.6	106
2007	4.6	103
2008	5.8	58
2009	9.3	45
2010	9.6	54
2011	8.9	58
2012	8.1	67
2013	5.8	73
2014 (est.)	6.2	

The bivariate data above can be graphed using a scatter plot using a coordinate plane. We can assign the *x*- and *y*-values as:
x = unemployment rate, and
y = consumer confidence

Example: Have students graph the data on graph paper using a scatter plot. See below for example of what it might look like.

Ask: Does there appear to be a correlation between the unemployment rate and the consumer confidence index?
Yes, there is a negative correlation between the unemployment rate and the consumer confidence index.

Remember, when two sets of data have a connection that can be described verbally or mathematically, there is a relationship. A correlation describes how strong the relationship is between the two variables. A positive correlation indicates that both values are increasing together. A negative correlation occurs when one value decreases as the other increases. In our example, consumer confidence decreases as the unemployment rate increases.

Class Activity – Using the Regression Line to Make Predictions
Note: You may want to use the "Using Regression Line" PowerPoint during this portion of the lesson as a visual for students.
The example above uses two economic indicators that have a strong effect on the health of our economy. Economists, politicians, bankers, and other leaders continually monitor these statistics to make predictions and decisions about what will happen next.

For example, the Federal Reserve System is the central banking system of the U.S. It is led by a person appointed by the U.S. President as the Chair of the Board of the Federal Reserve System (also known as “The Fed). Using data such as the unemployment rate and consumer confidence index, the chairperson has the authority to raise or lower interest rates. When the Federal Reserve raises or lowers interest rates, this becomes very newsworthy, especially in financial news.

Ask: *Why is this news?* The Federal Reserve loans banks and other private lending institutions money, and they then lend money to the public (through personal loans, mortgages, car loans, etc.) When interest rates are cut, banks are paying less for the money they borrow and are able to charge less when they lend money to businesses and the public. Also, stock markets tend to rise because when people borrow more, they are buying more, which means companies are earning more, causing their stock to rise.

Take a moment to show your students through a Google search where they can find government data such as Federal Reserve rates and related stock index prices.

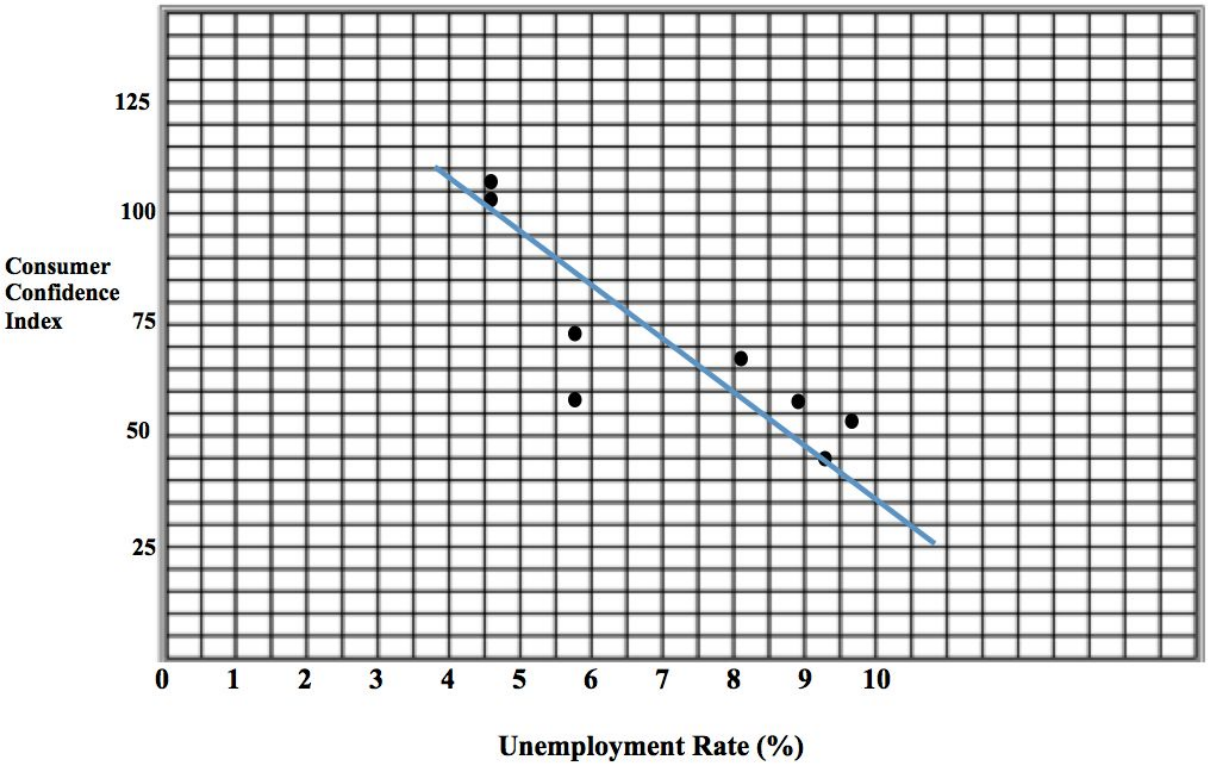
Read and respond:
Hand out the Associated Press news article on the U.S. economy to the class. There are two versions, one from the Associated Press and the same article printed in the Seattle Times. Ask students to take a few moments to read and then determine which statistics were used to describe the economy. Then ask them to explain what they think will happen to the interest rate based on the article.

As we saw from the article, there are a lot of measures used to describe our economy. Decisions (by the Federal Reserve for example) will be made based on those numbers. However, *how do we know that the economy will continue to improve?*

Regression line class exercise
As seen in the scatter plot above, consumer confidence decreases as the unemployment rate decreases. Since we don’t know the consumer confidence index for 2014, we can predict its value using the graph.

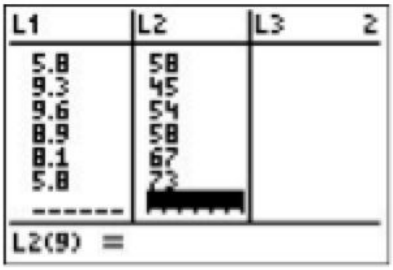
We can use a model to make predictions based on the previous data. The model that we will be using is a linear model called the **regression line** or **line of best fit**. When two variables are linearly related, we can use a line to describe their relationship. We can also use the equation of the line to predict the value of the x-variable based on the value of the x-variable.

The regression line (or line of best fit) is a line drawn in the scatter plot in which the distances from the points to the line are as short as possible. We can draw a line in the graph, as shown below, to approximate the regression.



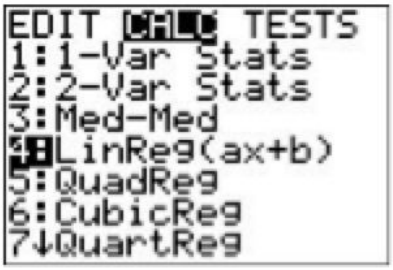
Explain that drawing the line by hand can lead to errors that will affect our predictions, so it's more precise and accurate to use a graphing calculator or computer program. Here are instructions for using the TI-84 calculator for graphing a line of best fit. You can project these instructions and ask students to follow along.

From the home screen, press the **STAT** button. Then select the **EDIT** option (#1).



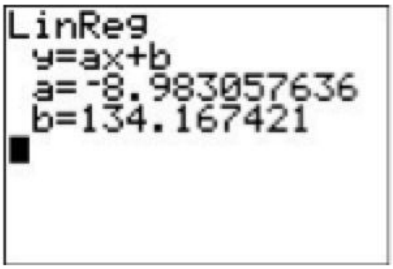
Enter all but the last x-values of the data set in **L1.** (Don't include the last value of 6.2)

Enter all the y-values of the data set in **L2.**



Press the **STAT** button. Select the CALC menu and then select #4: **LinReg(ax + b).**

Enter **L1**, **L2** (separated by a comma on some versions.)



We are given the equation of the regression line by the calculator as $y = -9x + 134.2$.

Ask: What is the context of the slope in this example?

The slope is –9. For every one percent that the unemployment rate increases, the consumer confidence index decreases by an average of 9 points.

Ask: What is the context of the *y*-intercept in this example?

The *y*-intercept is 134.2. This means that if the unemployment rate was 0%, the average consumer confidence would be measured at 134.2.

Now that we have an equation for our line of regression, we can predict the average consumer confidence level for 2014. Substitute the *x*-value of 6.2 into the equation and solve for *y*.

$y = -9x + 134.2$

$y = -9\mathbf{(6.2)} + 134.2$

$y = -55.8 + 134.2$

$y = 78.4$

So, the average consumer confidence level for 2014 was 78.4 points.

Life Expectancy Pair Activity
Pair students up and ask them to complete the Life Expectancy activity based on the articles provided in the materials section. Once pairs have finished, spend a few minutes as a class going over the scatter plots they created and clarifying/correcting as needed.

Wrap Up Brainstorm and Exit Ticket Assessment
Understanding data is a crucial segment of news literacy. Not only do we need to understand the data that is presented in the news, but we are required to analyze it as well. We can make predictions when there is a relationship in the data. If we model that relationship, such as with a regression line, we can predict where other variables will lie within our data. Predictions are often used to shape decisions.

For example, if the temperature is predicted to be cold tomorrow, then we decide to wear heavier clothing.

We rely on the news medium to report on decisions that impact our lives. For example, when interest rates are lowered, we know that we can borrow more money (at lower rates) in order to spend more. When interest rates are raised, then it will cost more to purchase goods (such as a house or car) on credit.

The decision to raise or lower interest rates is based on data from economic indicators such as the unemployment rate and consumer confidence index. Representatives from the Federal Reserve System make predictions based on this data.

Based on what they've learned so far and their experiences using data, ask students to brainstorm a "how-to" guide for using data found online. What advice or guidance would they give a classmate who is just beginning to use and interpret data?

Assign students to complete their exit ticket assessment, either individually or in pairs. The assignment is located in the materials section.

Extension Activity

If students need more practice applying these formulas and concepts, you can assign the Extension Activity located in the materials section. The activity is designed to be completed in a group of 2-3 students.

Materials: Using Regression Line Model to Make Predictions

1. Life Expectancy Pair Activity Worksheet
2. Pair Activity Answer Key
3. Exit Ticket Assessment
4. Exit Ticket Answer Key
5. Extension Activity — Predicting Fashion Trends
6. Extension Activity Answer Key

Life Expectancy Pair Activity

Guiding question: Is a country's economy a factor in the life expectancy of its population?

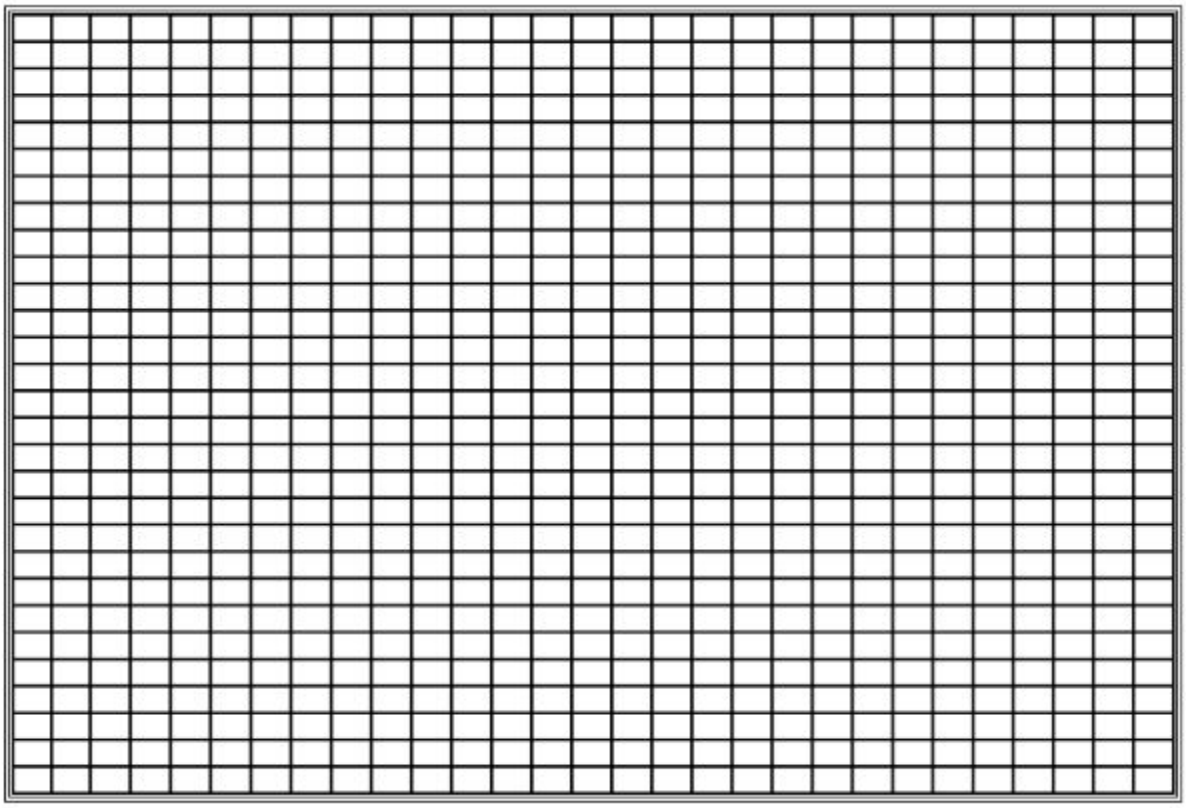
Directions: Read the article below and determine the regression line from a set of data. Use the line to make predictions, and answer the questions that follow.

Read
CBS news article
http://www.cbsnews.com/news/life-expectancy-rises-in-every-region-but-one/

The table below lists the overall life expectancy of 10 countries and their gross domestic products (GDP).

Country	Gross Domestic Product (in trillions of dollars)	Average Life Expectancy
France	2.8	82
Argentina	0.6	76
United States	16.8	80
Zimbabwe	0.01	54
Italy	2.1	83
China	9.2	76
Saudi Arabia	0.7	74
South Africa	0.4	61
Mexico	1.3	77
India	1.9	65

1. Make a scatter plot of the bivariate data. Is there a correlation? Are there any outliers?



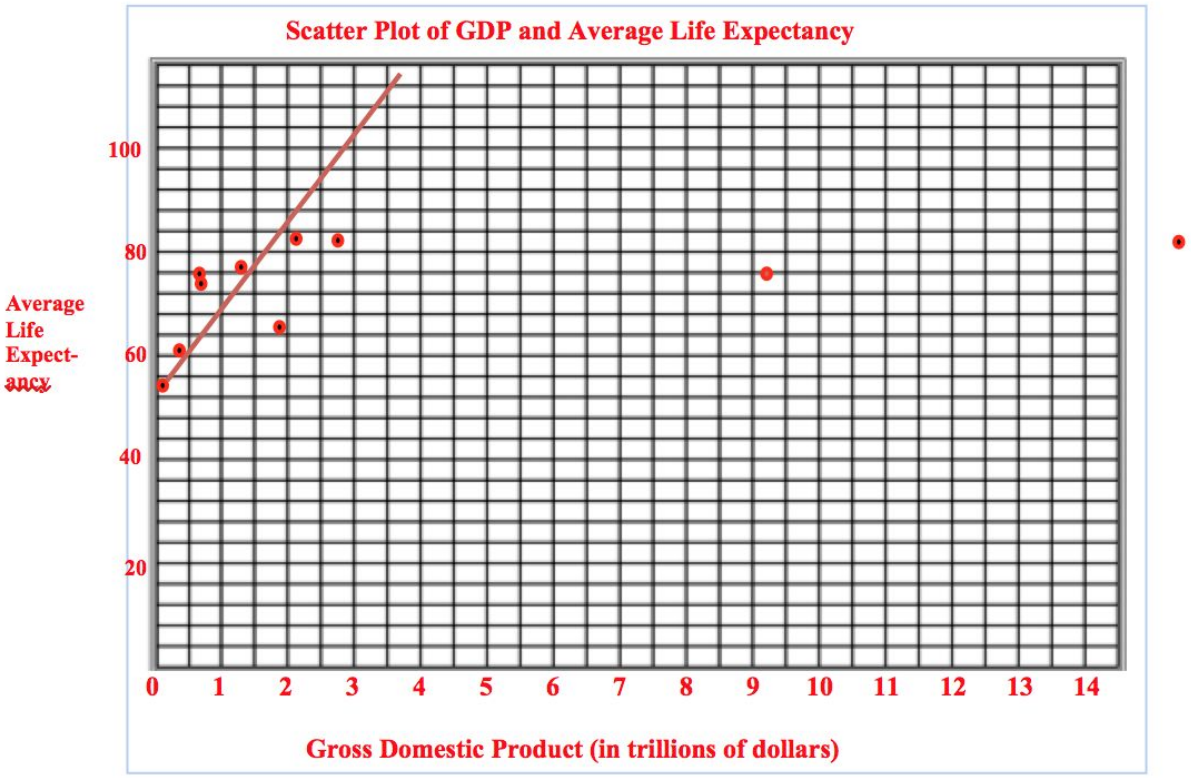
2. Based on the data, what is the equation for the regression line?

3. Using your equation, determine the life expectancy of residents of Kenya, which has a gross domestic product of $0.5 trillion.

4. The gross domestic product measures the national income and output for a given country's economy. The GDP is equal to the total expenditures for all goods and services produced within the country. Do you believe that the GDP is an indicator of the life expectancy of the population? Explain your answer.

Life Expectancy Pair Activity
ANSWER KEY

1. There is a positive correlation between gross domestic product and life expectancy. The United States and China are outliers.
2. $y = 0.72x + 70.2$
3. 70.56 years



Exit Ticket Assessment — Predicting Economic Outlook

Objective: Students will be able to determine the regression line from a set of data and use the line to make predictions.

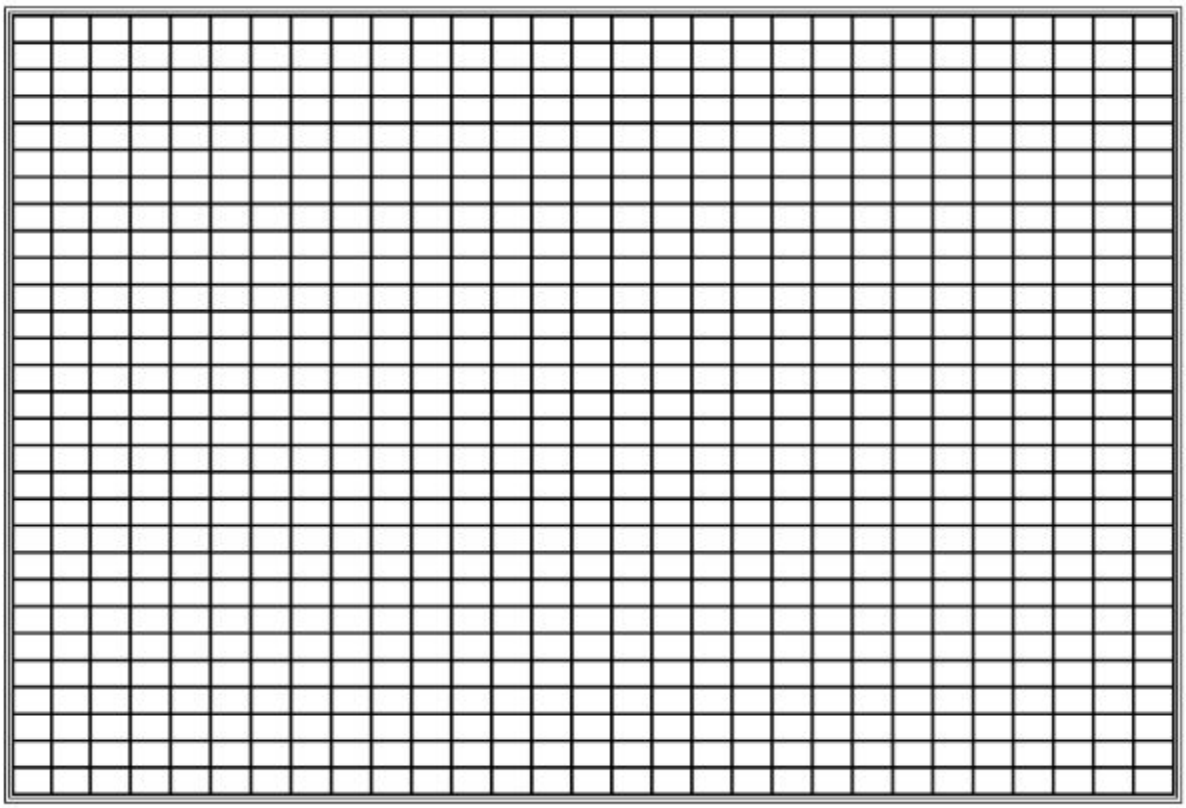
Directions: Answer the questions below based on the data.

The table below lists the average consumer price index for the years 2008–2014 and the average adjustable rate mortgage for those years.

Year	Consumer Price Index	Average Bank Mortgage Rate (%)
2008	215	5.9
2009	215	5.1
2010	218	4.8
2011	225	4.6
2012	230	3.8
2013	233	3.9
2014	237	4.0

The consumer price index measures the change in the price level that consumers pay for certain goods and services. It can be an indicator of inflation and the cost of living. The CPI can also be used to measure the value of salaries, prices of goods, and the value of a dollar. It is one of the most closely watched national economic statistics.

1. Make a scatter plot of the bivariate data. Is there a correlation?



2. Based on the data, what is the equation for the regression line?

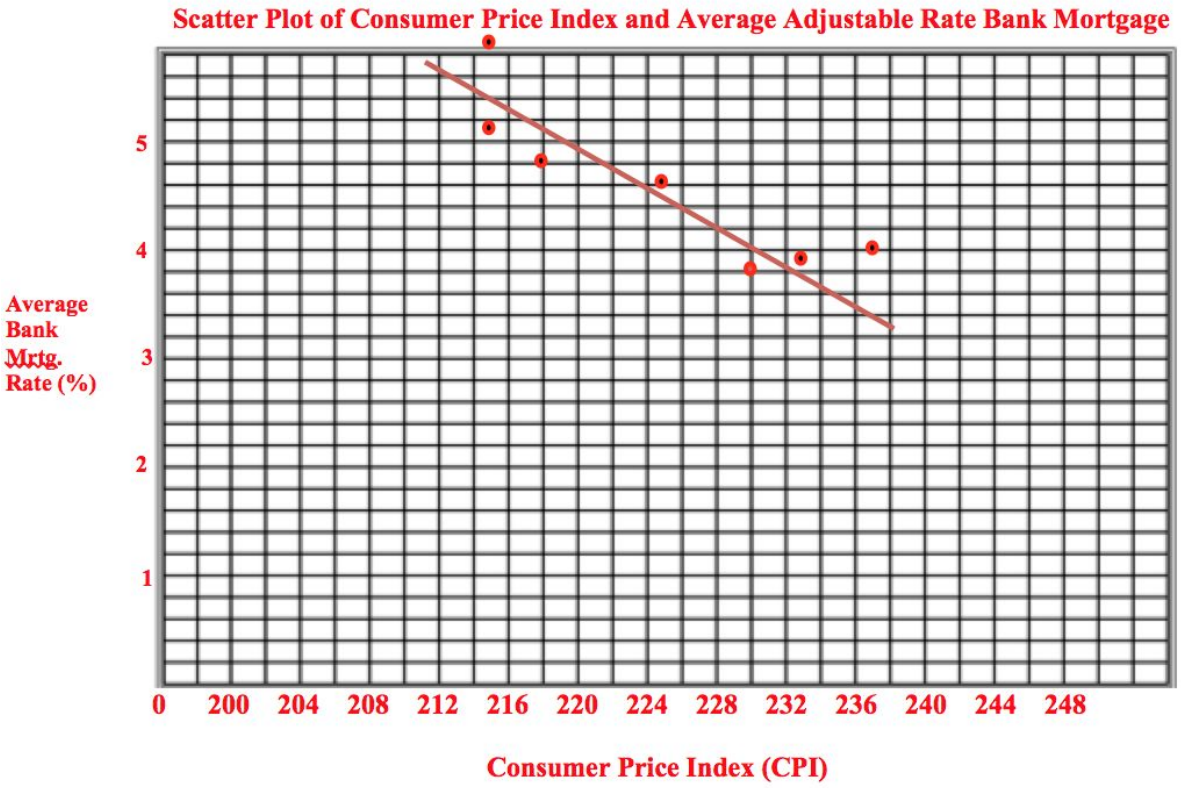
3. Using your equation, predict the mortgage rate for a consumer price index of 240.

4. Based on the trend of the consumer price index (CPI) and other economic indicators, a government economist estimates that the CPI for the first quarter of 2015 will be 240. The economist announces that due to the rise in the CPI, she will recommend an increase in mortgage rates.

As a reporter, you are assigned to interview the economist. What are some questions that you would ask her? Use your data from above.

Exit Ticket Assessment
ANSWER KEY

1. There is a negative correlation between the CPI and mortgage rates.
2. $y = -0.075x + 21.5$
3. 3.5%
4. Students should ask why the economist is recommending raising the mortgage rate, when it should actually be lowered based on the regression line model.



Extension Activity — Predicting Fashion Trends

Objective: Students will be able to determine the regression line from a set of data and use the line to make predictions. Read the follow information below, and the complete the exercises.

First, read this article:
http://www.nytimes.com/2013/08/27/fashion/how-to-tell-the-fashion-future.html?pagewanted=all&_r=1&

Introduction
"Regression analysis" is a tool that has been used to measure the relationship (if any exists) between two or more variables. With bivariate data – data that consists of two variables – connections can be measured between the two variables. One type of connection, or relationship, is a linear regression that can be represented with a regression line, also called a "line of best fit."

News organizations report on their sources' interpretations of many different types of regression analyses. For example, economists have been using different variables to predict trends in the financial markets for years. In the transportation industry, analysts use bivariate data to study traffic patterns during different times of the day.

Studying Data in the Consumer Market
Another use for bivariate data is to measure demand in goods or services. For instance, how high will consumers pay for a new smartphone? Will they even *want to buy* a new smartphone?

But are comments made on social media sites such as Twitter and Instagram considered data? And can that data be used to predict trends in fashion?

According to fashion researchers, there is a growing movement to use data to predict next season's top fashions. To analyze data on a graph, the values must be quantitative (numerical). In the fashion research, statisticians assign numerical ranks to the comments posted on the social media sites. Researchers then study the relationship of the data with pricing, styles, fabric, etc.

What's In for Next Season?
Let's look at the following example: At several recent fashion shows, spectators, designers, and consumers posted comments on the shade of the colors featured on

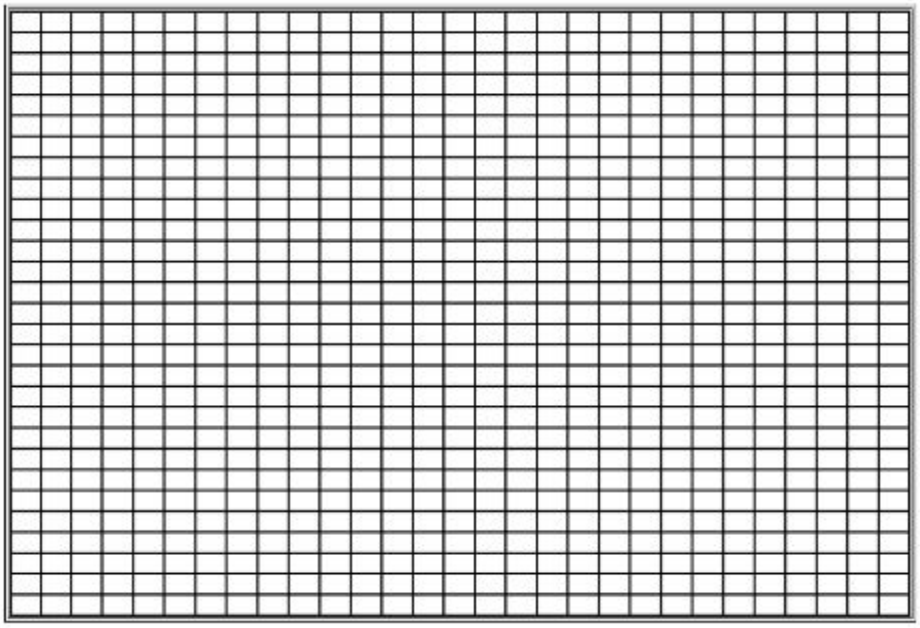
dresses worn on the runway. The shades of colors were assigned numerical values from 1 (very light) to 50 (very dark). The comments were ranked on a scale of 1 (Not appropriate) to 10 (Best-seller potential). The table below shows the data collected from the shows.

Color Shade	Comment (Avg.)
2	4.2
38	9.0
12	2.3
27	7.2
22	6.5
50	5.8
34	8.6
1	2.4
15	3.6
30	8.7
41	7.8
46	8.4

At the same shows, the numerical values were assigned to the fabric from 1 (sheer/lace) to 200 (canvas/thick denim). The comments were ranked on a scale of 1 (Not appropriate) to 10 (Best-seller potential). The table below shows the data collected from the shows. The table below shows the data collected from the shows.

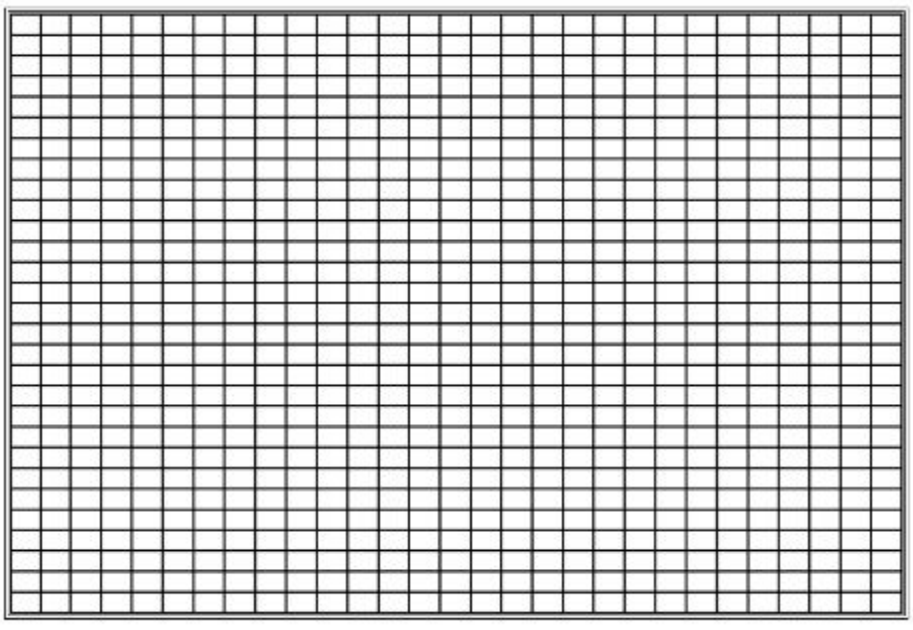
Fabric	90	65	140	30	12	160	25	88	15	190
Comment (Avg.)	3.7	6.1	3.8	9.2	9.4	1.2	8.5	5.2	9.0	2.9

1. Make a scatter plot of the average comment based on the shade of color. Is there a correlation?



2. Based on the data, what is the equation for the regression line?

3. Make another scatter plot of the average comment rank from the fabric. Is there a correlation?



4. Based on the data, what is the equation for the regression line?

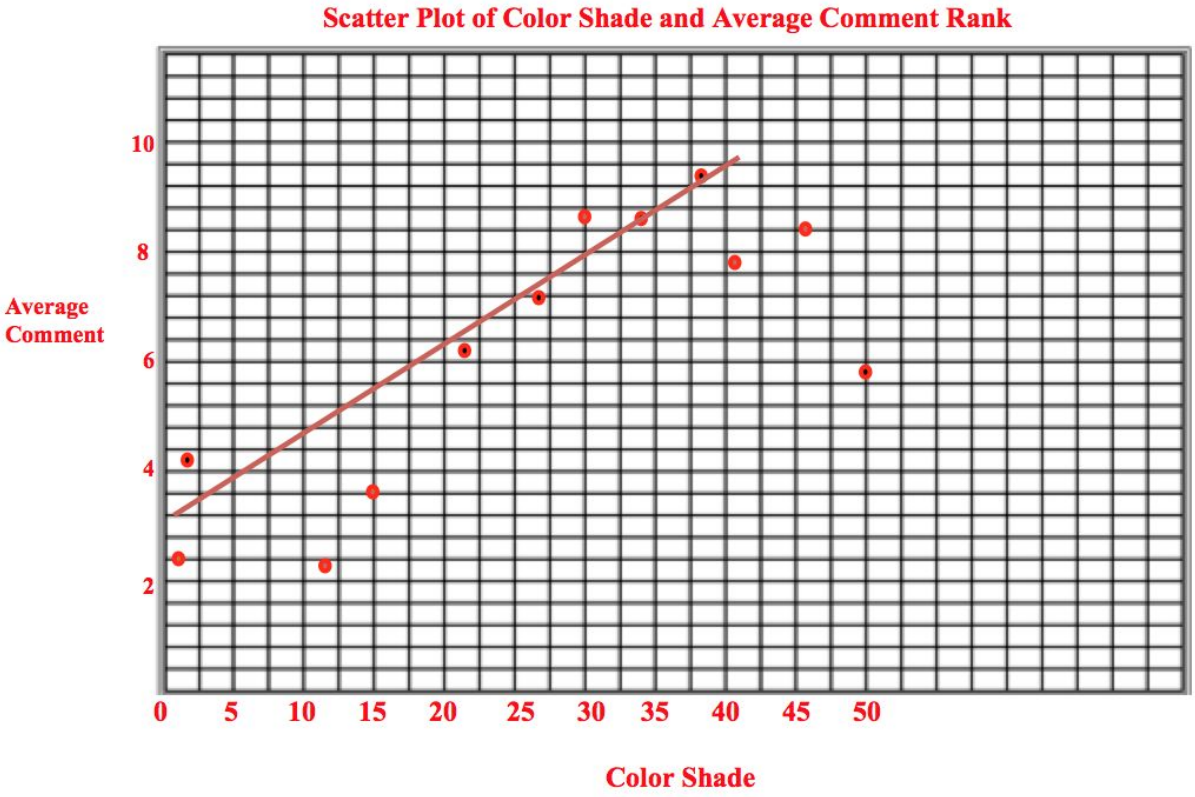
5. How would consumers react to a dress design with a medium shade (color = 25)? Explain your answer.

6. How would consumers react to a dress design with a messaline fabric (thickness = 10)? Explain your answer.

7. You've been asked to design an evening dress for next season. What shade of color and type of fabric would you use to design your dress so that it will be seen as popular and generate large sales? Use the data to support your answer.

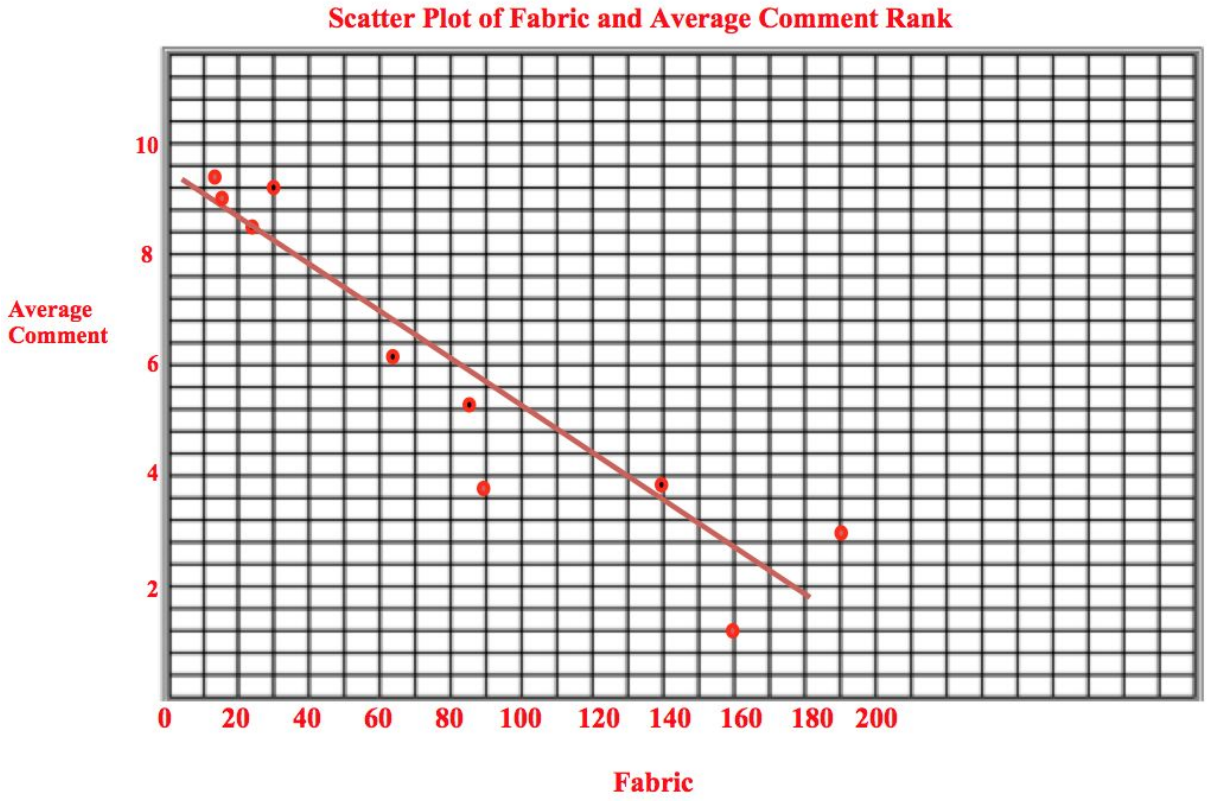
Extension Activity
ANSWER KEY

1. There is a positive correlation between color shade and the comment rank.



2. $y = 0.117x + 3.1$

3.



4. $y = -0.044x + 9.46$

5. Substituting the value into the equation, a medium shade would generate a comment rank of 6.025 out of 10. This would receive mixed reviews.

6. Substituting the value into the equation, a dress made of messaline would generate a comment rank of 9.02out of 10. This would be seen as very popular by consumers.

7. Based on the data, a dress made of a light fabric and dark color will be very popular next season and generate the best sales.

News Literacy Model Curriculum in Math
Grades 11/12

Lesson 1: Financial Literacy

Lesson 1

Financial Literacy

In this lesson, students will be introduced to the concept of financial literacy and its importance to their futures. This lesson serves as a hook for further study of personal finance, but it can act as a stand-alone lesson, as well. Students will recall the financial crisis and its causes and will explore contemporary news media related to finances.

Grade Level: 11-12
Required Time: 45-60 minutes

Learning Objectives

Students will:

- Understand the importance of financial literacy and their right to understand their personal finances.
- Read and interpret graphs.
- Evaluate how consuming news media helps keep them informed on local/national events.

Guiding News Literacy Question: Why does news matter?
The news media is expected to not only report on major occurrences but also to hold people and institutions responsible when they contribute to events that negatively impact citizens. In exploring the financial crisis through the lens of both advertising and news media, students can better understand how journalism's professional practices and ethical standards help promote financial literacy by exposing wrongdoing and educating citizens.

Common Core State Standards

S-IC.6	Evaluate reports based on data
Standards of Mathematical Practice 2	Reason abstractly and quantitatively.
Standards of Mathematical Practice 3	Construct viable arguments and critique the reasoning of others.

Materials

Money Talks article from the New Yorker
http://www.newyorker.com/magazine/2014/08/04/money-talks-6

Google finance page of 10-year view
https://www.google.com/finance?q=INDEXDJX%3A.DJI%2CINDEXSP%3A.INX%2CINDEXNASDAQ%3A.IXIC&ei=x7GRVNmGENSt8gb75YGYBA)
Group Internet access

Preparation
Teachers will want to read the Money Talks article in advance and create either an excerpt or a condensed version. The first five paragraphs and the last paragraph are recommended.

Students should be seated in pairs or small groups, three-four each.

The day before the lesson, have students ask their families if they remember what happened to the economy in 2008/2009, and what the details were. They should ask their parents: where did you get information on what was happening and the contributing factors?

Instructional Plan

Building background

Begin class by asking students: *Who has power in this country?*

Give them two minutes to write in their notebooks, then share in groups of three or four (pairs would be fine as well, depending on the set-up of the classroom). Walk around and listen to conversations. Ask two to three students to share something they heard in their groups. Record ideas on the board. Allow students to respond to each other if there is disagreement.

You want to get to this idea: The people who control the money control the power. Ask students what evidence they have of this in our daily lives. Ask them what jobs these powerful people have, and make a list on the board. If no one says so, ask students if people with money might even have some political power (example: which large companies can afford lobbyists, campaign contributions, bank bailouts, tobacco/soda industry, etc.).

Read and respond

Now distribute the article “Money Talks.” Read the whole article (or excerpt) aloud, popcorn style (students self-select as readers, changing each paragraph). Depending on the literacy level in the class, students may also read independently, followed by a group or full class discussion.

Instruct students to annotate and text code as they read. This means they will underline important words or ideas, circle words or ideas they do not understand, and take notes in the margins on important ideas or questions that they have. Stop to clarify circled ideas. Ask a student to summarize the ideas of a paragraph that was just read. Encourage questions and allow students to answer each other’s questions.

When finished, ask students what new ideas they got after reading the article. Then ask: *who are the people in our society who understand how money works? What do you think they studied in school?* Tell students that “finance” is what you study in school to become one of the “priests” of money. Finance is math! If you can understand this, you can protect yourself.

Application

Ask students what they know about the financial crisis of 2008/2009. Make sure that everyone understands that many people were given mortgages that they could not

afford to pay. Ask students why someone would agree to a mortgage they could not pay, based on what they have just read.

Display the Google Finance page (link provided under resources). Give students five or more minutes to talk to their group/partner about what information is displayed in the graph. Walk around and listen to conversations. If any are stuck, ask them questions about the independent/dependent variable, how much time is being covered, any major things they notice in the behavior of the graph.

Call the class back together and ask them what they determined in their groups/partners. Label independent/dependent variables and identify the units for each. Point out title and scale.

Explain to them that this is a graph of the average behavior of many stocks. (See if anyone knows what the Dow Jones or S&P are.) Elicit from students that this graph covers about 10 years of stock prices, from 2005-2014. Ask them what major event seems to have happened, and what possible explanation could be behind the stand-out behavior of parts of the graph. They should notice the giant dip in stock prices around 2008/2009. Emphasize that low financial literacy has larger effects beyond just personal situations — it can tank the economy of a whole country!

Evaluating current news media

Now, have students return to their groups and use the Internet to find current news articles (or even advertisements) that clearly take advantage of readers' low financial literacy or describe how financial institutions prey on those who don't know better. Once they find an example, the group should answer the following questions and be prepared to share their findings with the class:

1. What message does this article send about finances and money?
2. Is that a positive or negative message, and why?
3. What might a person with low financial literacy think of this message?
4. What might a person with high financial literacy think of this message?
5. What is the risk in misunderstanding the financial message of this article?

Assessment

Display the following questions, or distribute them on a worksheet (found in the materials section), and ask students to spend some time answering them in their notebooks:

> Why is financial literacy important? Give a specific example.

What would you like to know more about in regards to money?

Describe a time in your life when something you read in the news did not make sense to you.

Think back to history class: What is another example of a time when information was kept from a specific group in order to keep power from them?

Ask students to share their answers to the assessment questions with their groups/partners. Then, share out as a full class.

Materials: Financial Literacy

1. Assessment/reflection worksheet

Financial Literacy Reflection Worksheet

Directions: In your class notebook or on a separate piece of paper, respond to the following questions using complete sentences. Your responses should demonstrate thoughtful consideration of the question and the lessons learned in class.

1. *Why is financial literacy important? Give a specific example.*

2. *What would you like to know more about in regards to money?*

3. *Describe a time in your life when something you read in the news did not make sense to you. How could you learn more?*

4. *Think back to history class: What is another example of a time when information was kept from a specific group in order to keep power from them?*

News Literacy Model Curriculum in Math
Grades 11/12

Lesson 2: Credit Cards, Interest, and Savings

Lesson 2

Credit Cards, Interest and Savings

Students will compare the messages that they get from advertisements with the factual information they can receive from the news. They will look critically at a credit card advertisement and decode it to find out what kind of deal is really being offered. They will complete an activity illustrating the dangers of running up credit card debt, and read about best practices for keeping debt at a minimum and achieving a good credit score.

Grade Level: 11-12
Required Time: One hour

Learning Objectives
Students will:

- Read advertisements skeptically and discern messages from them.
- Solve problems involving interest rates and exponential growth.
- Understand the inherent bias in an advertisement.
- Identify news sources that can give objective assessments of the financial market.

Guiding News Literacy Question: How can students know what to believe?
Credit card companies often prey on the ignorance of consumers who do not fully understand the implications of spending on credit. News articles designed to empower readers with accurate financial information can help safeguard consumers, especially teenagers who may be acquiring their first credit cards.

Common Core State Standards

S-ID	Making inferences and justifying models.
F-LE	Linear, Quadratic, and Exponential Models.
Standards of Mathematical Practice 1	Make sense of problems and persevere in solving them.
Standards of Mathematical Practice 2	Reason abstractly and quantitatively.
Standards of Mathematical Practice 3	Construct viable arguments and critique the reasoning of others.
Standards of Mathematical Practice 4	Model with mathematics.

Materials

Credit Card Ad Example to show or hand out
Class Set Credit Card Statement Balance Worksheet
Graph Paper
Laptops
NY Times Article: For Better Credit Scores, Max out Payments, Not the Card
http://www.nytimes.com/2014/05/10/your-money/for-better-credit-score-max-out-payments-not-the-card.html?_r=1)
Internet access

Preparation

Students should be seated in partners or small groups of three-four.

Instructional Plan

Do now activity

When students come in, have the following written on the board or SMARTboard:

How do you think banks and credit card companies make money?

Have students respond to the prompt for five minutes and then ask them to share their answers with the full class.

Building background

Ask students if any of them or their parents have a credit card (they can answer with raised hands). Ask them if anyone can explain how a credit card works. Get as much information from them as possible, putting important ideas on the board. Topics that should come from this conversation are: interest/rates, fees (annual/late), monthly payments. Make sure before moving on that students understand what these terms mean.

Paired discussion — Understanding advertising media

Display the Credit Card Example file (either on a SMARTboard/projector, or as a printout for students to look at in their groups). First, ask student what the purpose of advertising is. Is it to convey information? To persuade? To tempt? Remind them that advertising is meant to create or suggest some kind of need, a reason to buy or purchase something. Ask: If the purpose of advertising media, whether print or online, is to persuade, how is this different from other types of media, like news media? News media's purpose is to inform, not to persuade.

Then, ask students to read through the ad and discuss with their partner/group what they think it means and to make a list in their notes of: things that seem good about the offer, things that seem bad about the offer, things that are confusing about the offer. Call on a few students to share out.

Ask if they agree with the tagline that claims that this credit card offer is "uncomplicated." (Students can answer by raising hands; call on one or two to elaborate as to their reasoning.) Ask students what part of the ad is actually quite complicated, or falls into the "financial jargon" that is referred to in the New Yorker article. They will probably notice the APR and percentages.

Close class reading and vocabulary

Go through the ad line by line with students, pulling out financial jargon:

-Credit
-Late fees
-Intro Rate/APR/creditworthiness
-Annual fee

Ask students: if you know that credit card companies make their money from us, how much can we trust them? What do we see in the ad that is meant to earn our trust? Who CAN we trust?

Discuss here the idea that if a source of information has something to gain, they are not a totally reliable source of information. Get a list on the board of sources of information that we can trust (examples can be specific news sources). Be sure to include OURSELVES! (We can trust ourselves if we can develop strong financial literacy.)

Critical analysis
Which part of the ad tells us how the credit card company will make their money from us? There is no annual or late fee (make sure students understand what these charges could be -- late fee is if you miss a monthly payment. Annual fee is a charge just to have the credit card at all. Things to look for when choosing a card!) Credit is the amount of money you are allowed to borrow from the bank. So, what is left? APR. Define for students that APR = Annual Percentage Rate and tell them that this is the way that the credit card company will make money off of anything that they will charge on their credit card each month—the interest they will charge (refer back to the beginning of class when this term was defined).

But, the credit card company won't just lend you that money for free. The only fee in the ad we are looking at is the APR. Let's look at the language in the ad. Have a student read the line in the ad related to APR. Ask students how long the APR is 0% (18 months). Ask students what math words they see (variable). As them what variable means (something that can change).

Group Activity
Distribute the Credit Card Statement Balance Worksheet. Ask the students to play out a scenario with their partners/groups, where for 6 months, they have no APR and can borrow money on their credit card without being charged any interest (the full 18 months would take too long). Tell them their credit limit is $2,000. They would receive a statement (or bill) every month, but since they have no late fees and no penalty rate, as the ad says, they will not be charged for paying nothing each month.

Still, if they have jobs and think they can pay anything back, they can feel free to enter payments. (This is a good opportunity to link debt and payments to positive and negative numbers for those who might struggle. It could be confusing because a negative balance on a credit card usually means that it has been over-payed, vs. a positive balance, which means that money is owed. To clarify, this can be compared to checking/savings accounts, where a negative balance means that an account is overdrawn.)

Walk around the room and make sure that six months was enough time for students to rack up some nice debt. You can brainstorm some ideas to get them started -- $200 shoes, a fancy restaurant dinner, jewelry for their partner, plane tickets to go on vacation.

Now tell them it is time for their APR to begin. Ask them to look back at the ad and say what they think “credit-worthiness” is and how “credit-worthy” someone their age probably is — do they think that a bank is going to give them a low APR? Agree on an APR that the whole class will apply to their bills. Now, have them apply their first monthly interest charge and write the new balance. They should continue for six more months, charging what they want, paying what they can, but each month adding interest and writing in the new balance.

Ask students to share out what their final balances are and what they seem to notice. Depending on time, have students graph their results and to identify what form of growth their balances are demonstrating. Depending on their payment habits, they may see something somewhat linear or exponential.

Class discussion

Now lead a discussion with the following questions (these can be made into a worksheet if you would prefer for students to write individually):

1. What would have happened if we had used the full 18 months of no APR before interest kicked in?
2. What would have happened if their credit limit was higher than $2,000?
3. Even though it seems like a good deal to have no penalty for paying nothing every month, what effect a penalty might have had on their spending or likelihood to pay something every month?
4. What would happen if a similar deal was offered to someone who needed a mortgage to buy a house, who had low financial literacy?
5. What do they think would happen to that person after their interest rate changed?

6. What kind of house do they think that person would assume they could afford to buy, if they were getting a mortgage similar to this credit card deal?
7. What do students think would happen to the banks when people couldn't pay back their mortgages?

Further research
Finally, distribute laptops. Tell students that this is part of what contributed to the financial crisis in 2008/2009. Ask them to spend ten to fifteen minutes with a partner, finding a news article about the financial crisis.

Tell them that they will need to share one cause, according to the media, of the financial crisis. After ten to fifteen minutes, whip around the room, calling on students to share the source of their information and the sources stated cause of the financial crisis. Record answers on the board.

Call attention to the sources that students chose and make sure to ask students if these are reliable sources, and how they know. Ask them if they notice any bias, or if there is any conflicting information. Ask them if the articles seem subjective or if they are opinion pieces. Ask: *how do they know?*

Ask students if they think they will ever want to borrow money or have a credit card. Many will probably say never. However, tell them that home prices, cars, college tuition, or things they need are sometimes very expensive, and they might need to borrow money some day. They will need to earn that good APR or interest rate by showing that they are trustworthy. Introduce the idea of a "credit score" and how it can lead to good interest rates.

Finding trustworthy sources
Ask students if they think they learned anything about financial literacy by looking at the credit card ad. Tell them that there are sources of information that they CAN trust, and we are about to read an example of that together. Distribute NY Times Article: For Better Credit Scores, Max out Payments, Not the Card (links found in the resources section).

Students should read the article independently. Instruct them, as they read, to underline anything that they think is reliable, unbiased advice about responsible credit.

Brainstorm
When students are finished reading, ask them, based on the article, what the best practice is for responsibly managing a credit card. Put their ideas on the board. Tell them that if they have a card with no fees and they pay the full balance every month, they will never pay the credit card companies a dime of their own money, and they will have a great credit score for the future.

As a summary, ask students to identify some other media sources that they think would give them better advice on how to manage their credit, instead of relying on ads. Ask them, as a review, why ads are not reliable (they are trying to sell a product). If there is time, ask students to look on laptops for other news articles online with unbiased advice about credit.

Materials: Credit Cards, Interest, and Savings

1. Credit Card Ad directions
2. Credit Card Statement Balance Worksheet
3. Extension Ideas

Credit Card Ad

Directions for teacher: Find a credit card ad that gives only basic information about applying and interest rates. Distribute copies of the ad or project via a SmartBoard.

Credit Card Statement Balance Worksheet

Congratulations on your new credit card! You have a $2,000 credit limit. Buy whatever you want! No penalties, no fees, no interest for six months.

Month #1

Item	Price

Interest: _____ Payments: _____ Total Balance: _____

Month #2

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #3

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #4

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #5

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #6

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

The party is over!! It's time for your APR to begin. The interest you will be charged every month on your outstanding balance is now: _____.

Month #7

Item	Price

Interest: _____ Payments: _____ Total Balance: _____

Month #8

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #9

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #10

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #11

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Month #12

Item	Price

Balance forward (last month's balance): _____

Interest: _____ Payments: _____ Total Balance: _____

Extension Ideas

1. Compare the interest rate on money borrowed to the interest rate on money saved. Use The New York Times Consumer Rates website (http://markets.on.nytimes.com/research/markets/rates/rates.asp) to research and compare different types of loans and savings accounts, and compare interest rates.

2. Produce a brochure or info sheet for members of the community about the dangers of credit card offers and best practices for safely managing credit.

3. Have students research the details of how subprime mortgages actually contributed to the 2008/2009 financial crisis.

4. Give students various borrowing/payment scenarios to model in a table and graph. They can identify/compare different types of growth and make a prediction about this person's financial future:

- A person who never pays their monthly balance.
- A person who always pays their monthly balance.
- A savings account.
- Different interest rates.

News Literacy Model Curriculum in Math
Grades 11/12

Lesson 3: Understanding College Loans — Debt and Compound Interest

Lesson 3

Understanding College Loans — Debt and Compound Interest

Students research the costs of college and of borrowing to pay for college. Depending on the grade level and time of year, students could use their actual financial aid packages as a starting point. They will also create budgets and predict how they will pay off their loans.

Grade Level: 11-12
Required Time: One hour

Learning Objectives
Students will:

- Develop familiarity with the types of financial aid offered by colleges.
- Describe compound interest, and calculate it based on the cost of a loan and rate of repayment.
- Gain perspective on the cost of college and use news sources to become skeptical of different financial options.

Guiding News Literacy Question: How can students know what to believe?
Financing a college education is ultimately one of the most important and consequential decisions a student will make. In the process, many seniors are bombarded with information from a variety of sources and perspectives. Sifting through that information is difficult, but finding the right sources and understanding the finances behind their choices will empower students to make excellent decisions.

Common Core State Standards

CCSS.MATH.CONTENT.HSS.IC.B.6	Evaluate reports based on data.
CCSS.MATH.CONTENT.HSF.LE.A.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
Standards of Mathematical Practice 1	Make sense of problems and persevere in solving them.
Standards of Mathematical Practice 2	Reason abstractly and quantitatively.

Standards of Mathematical Practice 3	Construct viable arguments and critique the reasoning of others.
Standards of Mathematical Practice 4	Model with mathematics.
Standards of Mathematical Practice 5	Use appropriate tools strategically.

Materials

Class set laptops or college brochures
Financial aid awards (if applicable)
Class set College Loans Anticipation Guide
Class set Planning Your Financial Future packet
Various articles for anticipation guide

- How Many People Don't Pay their Student Loans? http://blogs.wsj.com/totalreturn/2014/12/05/how-many-people-dont-pay-their-student-loans/
- Student Debt: The Rising US Burden http://www.bloombergview.com/quicktake/student-debt
- US College Students Face High Debt, Shattered Dreams http://america.aljazeera.com/opinions/2014/10/for-profit-collegestuitionhighereducationstudentloans.html
- Will College Ratings Make Education More Affordable? http://www.newsweek.com/will-college-ratings-make-education-more-affordable-295616
- College Costs Slow Down, But Aid Falls And Average Student's Debt Hits $27K http://www.forbes.com/sites/halahtouryalai/2013/10/23/college-costs-slow-down-but-aid-falls-and-average-students-debt-hits-27k/

Websites

Various college websites
Federal Student Aid Interest and Loans
https://studentaid.ed.gov/types/loans/interest-rates
A Beginner's Guide to Paying for College
http://www.nytimes.com/2014/05/17/your-money/paying-for-college/a-beginners-guide-to-repaying-student-loans.html
Student Loan Repayment Calculator
http://www.nytimes.com/interactive/2014/your-money/student-loan-repayment-calculator.html

College Degrees with the Highest Starting Salaries
http://www.forbes.com/sites/susanadams/2013/04/15/college-degrees-with-the-highest-starting-salaries-3/

Preparation
Depending on grade level and time of year, ask students to bring in their financial aid packages or FAFSA information. Otherwise, allow students to select a college that they think they may want to attend. If they are unsure, ask them to research the two- and four-year programs in your city or state. For students who are not planning to attend college in the fall, they should select a career, research a projected salary, and then proceed directly to the Part 3 budgeting activity.

Students should have completed the “College Loans Anticipation Guide” provided in the materials section. There are several articles to choose from, but all students should answer the questions on the guide. Distribute the articles so that no more than three-four students are reading the same articles, or allow students to choose which article they would like to read. Depending on the literacy level of the students, it may be appropriate to assign more than one article to certain individuals. Either way, make as many, or as few articles available to students as they would like. For every article a student is assigned, make sure they have a separate copy of the Anticipation Guide so that they can respond to each article separately.

Instructional Plan

Review
Review the terms with students: loan, interest.

Have students take out their College Loan Anticipation Guides and ask them to give a synopsis of the article that they read, and how reading the articles made them feel. Discuss for no more than five to ten minutes (although if a heated discussion happens, the lesson can be split into two periods).

Research
Distribute the “Planning Your Financial Future” packet and laptops, while students take out their financial aid packages (if applicable).

Direct students to fill out Part 1 using information from their chosen college. This can be done by using the information provided to them by the college, or online. It would be valuable for students to start familiarizing themselves with their college website.

For Part 2, regardless of the financial aid package that the student has been offered, ask students to complete the table and questions by using the information at Federal Student Aid Interest and Loans website (link under resources). Allow them to explore the site further, if they are so inclined. Walk around the room and make note of students who may have learned something new from the site, and have them share out when you go over Part 2 as a class. Have students work individually or in pairs for this part. When they have finished, gather the class back together to share answers (key below).

Loan Type	**Interest Rate**	**Fee**
Direct Subsidized	**4.66% fixed, no interest charged before graduation**	**1.073%**
Direct Unsubsidized	**4.66% fixed, interest accrues immediately**	**1.073%**
Perkins	**5% fixed**	**None (except for late/missed payments)**
Private	**2% to 18% variable (can change over time)**	**0% to 10%**

Ask students what the benefit of a fixed interest rate is over a variable interest rate. Ask students the dangers of a variable interest rate, and tie this back to subprime mortgages. Ask them what interest rate they would probably be offered on a private loan.

The teacher can relate this to the previous lesson on the credit card offer — people with bad/no credit history will not be offered very low interest rates. Ask students why anyone might take out a private loan to pay for college. The answer to this would be that not all students will be offered federal loans, which the Direct and Perkins are examples of. Also, college may cost more than the federal loans will cover. This is a good time to ask students to look at their financial aid offers from colleges and see if they might need to take out additional loans, themselves.

Make sure to go over all answers to Part 2, making sure that students understand how interest on a loan is calculated (they'll need this in Part 3). There is a nice explanation from the website that students may have discovered for themselves:

Outstanding principal balance
x number of days since last payment
x interest rate factor
= interest amount

Direct students to Part 3. Tell them to use the cost of college from Part 1, combined with their financial aid offer, to determine how much student debt they will have accrued by the time they graduate. It may be helpful to brainstorm with students what other expenses they may have, which were not covered in Part 1, and what other sources of income they may have while they are in school.

When students get to #11, gather them back together as a class. Ask them to look at Student Loan Repayment Calculator (link provided in resources). The teacher may want to project this on a SMARTboard or projector, but it is not necessary. Allow students to fill in the fields on the website and play with the sliders a bit to see what changes. Ask them what factors can affect the length of time it could take to pay off a loan. Possible answers could be career/salary, other expenses. Give students time to answer #11 and share their answers and how they got the answers. Students may talk about the salary they think they may earn in their chosen careers.

Project the chart from the Forbes article, College Degrees with the Highest Starting Salaries (link provided in resources).

Ask the students to identify the source of this information, at this point. Make the distinction that just like banks, colleges are businesses. Ask students to look at their college brochures and ask if they can identify anything in the brochures that feel like advertising to them.

Analyzing information

Then ask them who we trust for unbiased information about a big financial decision, like paying for college — the ad for the private loan, the ad for the college, or the two news sources we just looked at and the student aid website?

How are all these sources different? How are intentions of each source different? If students were to rank these sources in order of helpfulness, bias, and accuracy, how would those rankings look?

Point out that the New York Times references the same student aid website (bottom of the loan calculator) that was used in the beginning of the lesson.

If there is time, students can read the “related article” linked on the Student Loan Repayment Calculator website, called A Beginner's Guide to Paying for College (link under resources). Make sure to have the class share out their reactions to the situation in this country related to the cost of college and student loans. Have them share their worries or fears. Ask them if they know anyone, a family member or friend, who is re-paying hefty loans, and if they can share their story.

Materials: College Loans — Debt and Compound Interest

1. College Loans Anticipation Guide
2. Planning Your Financial Future Packet
3. Extension Ideas

Name: Date:

College Loans Anticipation Guide

Directions: Read the article that was assigned to you, and answer the questions below on a separate piece of paper. Be prepared to share your answers in class tomorrow.

1. What was the title and source of the article?

2. Do you think the information from this source is reliable? Why? (You may want to research this for yourself!)

3. Summarize the article that you just read.

4. Make a list of specific surprising or important facts from this article that you think your classmates should know.

5. How do you feel about earning a college degree, after reading the article?

6. What do you think happens if you borrow money to pay for college and are unable to finish your degree? How do you feel about this?

Name: Date:

Planning for your financial future

Congratulations! You have been accepted to: _____

Directions: Use a laptop or information you have received from your school to answer the questions.

Part 1: Costs of attending college

1. How much is tuition for just one year of school? _____

2. How much is tuition going to be for your whole degree? _____

3. How much are your student expected expenses for one year? _____

4. How much are your student expected expenses for your whole degree? _____

5. Overall, how much are you expected to pay for your college degree (including tuition and student expenses)? _____

Part 2: Choosing a loan

Use the information at http://studentaid.ed.gov/types/loans/interest-rates **to complete the table below. And answer the questions. Only use the most current information pertaining to undergraduate loans.**

Loan Type	Interest Rate	Fee
Direct Subsidized		
Direct Unsubsidized		
Perkins		
Private	**2% to 18% variable (can change) over time**	**0% to 10%**

6. What is interest? Why do banks charge interest on loans?

7. How is interest calculated?

8. What does it mean for a loan to *accrue* interest?

Part 3: Cost of your loan

9. How much money will you owe, and in what form, by the time you graduate from college? Use the chart below to help organize your college budget. Show all calculations.

Assets (grants, work study, job income)		**Debt (loans plus interest, other expenses)**	
Name	Amount	Name	Amount
Total Income:		**Total Expenses:**	

10. How much of this money is interest only? Show your calculations below.

11. How much time do you think it usually takes people to pay off their student loans? Why?

12. Go to
http://www.nytimes.com/interactive/2014/your-money/student-loan-repayment-calculator.html
How much time might it take you to pay off your student loans? What factors contribute to the length of time it could take to pay off these loans?

13. How much interest will you have paid by the time you have finished paying your loans? Your answer can be an estimate or a range.

Extension Ideas

1. Have students project into the future. What will happen when they graduate from college? Choose a career and estimate a salary. Look at padmapper.com and figure out how much they might pay in rent. Once the student has chosen a salary and a place to live, have them re-create the budgeting chart from the class activity, including their adult post-college expenses (rent, cell phone, bills, etc), loan payments, and income.

2. Review the formula for compound interest and incremental interest. Have students create a graph with yearly, monthly, daily, and compound interest, based on their loan cost. Ask them what they notice. Discuss the idea of compound interest as a limit as the time increments get infinitely smaller.

3. Have students research ways that compound interest can earn them money and add this to their budgets.

4. Several of the anticipation articles refer to the particularly high student debt on certain populations, such as low income students. Have students read the rest of the articles and research the effect of student debt on the community that they identify as a member of, or other communities, in more detail. (Examples: low income, undocumented, recent immigrant, rural/urban, etc.)

5. After researching the high costs of college and student debt in America, ask students to research the costs of college and debt in other countries, and reflect on the differences.

Helpful News Literacy Resources

The following resources have been culled from an extensive database of news literacy projects. They provide useful starting points for the novice news literacy teacher and offer ideas for curriculum extensions and classroom activities. They have been broken down into topical categories for easier reference.

Understanding News Literacy

1. Harvard University - Berkman Center for Internet & Society
    - *The Challenges of Defining 'News Literacy*
      http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2342313
    - *Mapping Approaches to News Literacy Curriculum Development: A Navigation Aid*
      http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2354500
    - Youth and Media Project
      http://youthandmedia.org/teaching-and-outreach/curricular-modules/information-quality-news-literacy-modules/

2. The News Literacy Project CHECK Infographic:
   http://thenewsliteracyproject.org/sites/default/files/Check%20Infographic%20Lesson.pdf

3. Journalism Education Association's Unit on Understanding News Literacy
   http://jea.org/blog/2013/07/24/lesson-plan-understanding-news-literacy/

4. Stonybrook Center for News Literacy
   http://digitalresource.center/

5. Pulitzer Center on Crisis Reporting
   http://pulitzercenter.org/education
   Whether you are looking to globalize your class, make connections to the local community, align your curriculum with Common Core standards, or bring your units alive with journalists fresh from the field, we want to work with you

Why News Matters and How News is Changing

1. The News Literacy Project's video on why local news matters
   http://www.thenewsliteracyproject.org/learn-channel/watchdog-journalism-local-news
   The News Literacy Project offers a free video (6:39) in which Elis Estrada, an associate producer for the consumer investigative unit at NY1 News, discusses the watchdog role journalists can play in their communities and how a local news story influenced change. Key teaching points: gather information from numerous sources, attempt to get all sides of the story and then present facts to the public, raise awareness about the issue, bring the issue to the attention of the government agency in charge.

2. The News Literacy Project's video on Tweeting Hurricane Sandy

http://www.thenewsliteracyproject.org/learn-channel/tweeting-hurricane-sandy-deception-and-knowing-what-believe
The News Literacy Project offers this free video lesson, (15:15).Maggie Farley, a former Los Angeles Times reporter, uses misinformation about Hurricane Sandy that spread via Twitter to discuss how to judge the credibility of tweets, including an example of tweets that falsely claimed the New York Stock Exchange was flooded potentially impacting world markets.

3. The News Literacy Project's video on social media during the Boston Marathon
http://www.thenewsliteracyproject.org/learn-channel/social-media-during-boston-marathon-bombing

   The News Literacy Project offers a free video (8:36). Nicco Mele, a lecturer at Harvard University's John F. Kennedy School of Government, discusses the benefits and pitfalls of social media during the Boston Marathon bombing and challenges students to figure out the answers to important questions about responsible use of social media including: How do you know what to believe? What opportunities does the Internet create? What are the disadvantages?

4. PBS's definition for "What's News"
http://www.pbs.org/wgbh/pages/frontline/newswar/view/16.html?c=2qt

5. The News Literacy Project's photo fact checking lesson
http://www.thenewsliteracyproject.org/learn-channel/photo-fact-checking-digital-age
Free video (6:31) includes a frog photobombing a photo taken of a NASA and other engaging examples. Explains why digital photos posted on social media and elsewhere online need to be checked, and shares easy-to-use tips and tools for verifying them.

Bias and Reliability

1. The News Literacy Project's Consumer's Guide to Sourcing in News Reports
http://www.thenewsliteracyproject.org/learn-channel/sourcing

2. The News Literacy Project's Salztman Seven Guide
http://thenewsliteracyproject.org/lesson-consumers-guide-sourcing-news-reports
The News Literacy Project offers this free video lesson (8:57). Paul Saltzman, assistant managing editor for projects at the Chicago Sun-Times, discusses sourcing in news reports and offers helpful guidance for evaluating a report's credibility. He offers 7 keys to evaluate the sourcing including: the number of sources, transparency of sourcing, authority, variety of sources, motives, anonymous sources and documents.

Additional News Literacy Resources for Math Teachers

The following resources may be helpful as supplementary or complementary content as you seek to develop a news literacy focus in your mathematics classroom.

1. The New York Times Learning Network for Mathematics
   http://learning.blogs.nytimes.com/category/mathematics/

2. Edutopia's Guide to Financial Literacy lessons
   http://www.edutopia.org/financial-literacy-resources
   This page links out to a host of other resources addressing money and financial literacy for students.

Lesson Credits

Shaun Errichiello — Grades 7/8 Lessons
Buffalo Blizzard
All the Ants
Counting the Hungry

Joe Fraioli— Grades 9/10 Lessons
What Luck! Probability in the News
Standard Deviation and ‘Calculating’ the News
Using Regression Line Model to Make Predictions

Meredith Klein — Grades 11/12 Lessons
Financial Literacy: Where can we find reliable information?
Credit Cards, Interest, and Savings
College Loans, Debt, and Compound Interest