I Can… Algebra II

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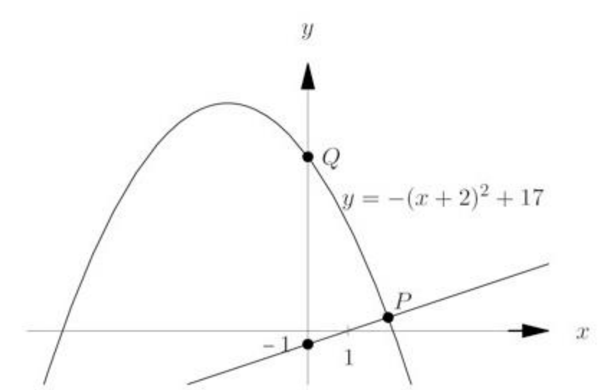
COUNTY PUBLIC SCHOOLS

🟩 **Major Content** ⬜ **Supporting Content** 🟨 **Additional Content**

	I Can…	*Example*	**I don't yet know it.**	**I need help from my teacher.**	**I sometimes need help.**	**I can do this all by myself.**	**I can teach this.**
The Complex Number System	**N-CN.1** I can know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form $a + bi$ with *a* and *b* are real numbers.	Joanne wants to graph a quadratic function whose roots are $5 \pm 2i$ and says: *I know the graph is a parabola, and the roots tell me that my function does not cross the x-axis, but I'm not sure where to go next—how do I use this information to help with my graph?* a. What can you deduce about the vertex of Joanne's parabola? b. What does Joanne's function graph look like? www.illustrativemathematics.org					
	N-CN.2 I can use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	Working with complex numbers allows us to solve equations like $z^2 = -1$ which cannot be solved with real numbers. a. Find all complex square roots of -1, that is, find all numbers $z = a + bi$ which satisfy $z^2 = -1$ b. Find all complex square roots of 1. c. Which complex numbers satisfy $z^2 = i$? www.illustrativemathematics.org					
	N-CN.7 I can solve quadratic equations with real coefficients that have complex solutions.	Find the solutions of the given equation. $2x + \frac{7}{x} = 4$					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
The Real Number System	**N-RN.2** I can rewrite expressions involving radicals and rational exponents using the properties of exponents.	In each of the following problems, a number is given. If possible, determine whether the given number is rational, irrational or cannot be determined. Justify your answer. a. $\frac{\sqrt{45}}{\sqrt{5}}$ b. $\frac{6}{\pi}$ c. $\frac{2+\sqrt{7}}{2a+\sqrt{7a^2}}$					
Arithmetic with Polynomial and Rational Expressions	**A-APR.2** I can know and apply the Remainder Theorem: For a polynomial *p(x)* and a number *a*, the remainder on division by *x – a* is *p(a)*, so *p(a)* = 0 if and only if *(x – a)* is a factor of *p(x)*.	Find the value of *a* if $x^3 + 8x^2 + ax - 2$.					
	A-APR.6 I can rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$in the form $q(x) + \frac{r(X)}{b(x)}$, where *a(x), b(x), q(x)*, and *r(x)* are polynomials with the degree of *r(x)* less than the degree of *b(x)*, using inspection, long division, or, for the more complicated examples, a computer algebra system.	Divide $3x^3 - 5x^2 + 10x - 3$ by $3x + 1$.					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
Reasoning with Equations and Inequalities	**A-REI.2** I can solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	Megan is solving the equation $\frac{2}{x^2-1} - \frac{1}{x-1} = \frac{1}{x+1}$ She says: "If I clear the denominators I find that the only solution is *x*=1 but when I substitute in *x=1* the equation does not make any sense. Is Megan's work correct? Does Megan's method produce an *x* value that does not solve the equation? www.illustrativemathematics.org					
	A-REI.4b-2 I can solve quadratic equations in one variable. b) Recognize when the quadratic formula gives complex solutions.	What is the solution set of $\frac{x^2}{2} = 5x - 17$?					
	A-REI.6-2 I can solve algebraically a system of three linear equations in three unknowns.	The currents running through an electrical system are given by the following system of equations. The three currents, I_1, I_2, I_3, are measured in amps. Solve the system to find the currents in this circuit. $I_1 + 2I_2 - I_3 = 0.425$ $3I_1 - I_2 + 2I_3 = 2.225$ $5I_1 + I_2 + 2I_3 = 3.775$ www.algebralab.org					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
	A-REI.7 I can solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.	Consider the linear and quadratic functions appearing in the figure.  **a.** What are the coordinates of the point Q? Use mathematics to explain your answer. **b.** What are the coordinates of the point P? Use mathematics to explain your answer. www.illustrativemathematics.org					
	A-REI.11-2 I can find the solutions of where the graphs of the equations y= f(x) and y= g(x) intersect, e.g. using technology to graph the functions, make tables of values or find successive approximations. Include cases where f(x) and/or g(x) are linear, quadratic, polynomial, rational, absolute value, exponential, and/or logarithmic functions.	The population of a country is initially 2 million people and is increasing at 4% per year. The country's annual food supply is initially adequate for 4 million people and is increasing at a constant rate adequate for an additional 0.5 million people per year. **a.** Based on these assumptions, in approximately what year will this country first experience shortages of food? **b.** If the country doubled its initial food supply and maintained a constant rate of increase in the supply adequate for an additional 0.5 million people per year, would shortages still occur and when? www.illustrativemathematics.org					

Algebra II

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
Seeing Structure in Expressions	**A-SSE.2-3** I can use the structure of polynomial, rational or exponential expressions to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.	Let *a* and *b* be real numbers that *a>b>0* and $\frac{a^3-b^3}{(a-b)^3} = \frac{73}{3}$. What is $\frac{b}{a}$?					
	A-SSE.2-6 I can use the structure of a polynomial, rational, or exponential expression to rewrite it, in a case where two or more rewriting steps are required.	Rewrite $\frac{5x^4-3x^3+6x^2+5x-7}{x+12}$.					
	A-SSE.3c-2 I can choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression, where exponentials are limited to rational or real exponents. c. Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $(1.15^{\frac{1}{12}})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.	Four physicists describe the amount of a radioactive substance, *Q* in grams, left after *t* years: **a.** $Q = 300e^{-0.0577t}$ **b.** $Q = 300(\frac{1}{2})^{\frac{t}{12}}$ **c.** $Q = 300(0.9439)^t$ **d.** $Q = 252.290\ (0.9439)^{t-3}$ a. Show the expressions describing the radioactive substance are all equivalent (using appropriate rounding). b. What aspect of the decay of the substance does each of the formulas highlight? www.illustrativemathematics.org					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
	A-SSE.4-2 I can use the formula for the sum of a finite geometric series to solve multi-step contextual problems.	Susan has an ear infection. The doctor prescribes a course of antibiotics. Susan is told to take 250 mg doses of the antibiotic regularly every 12 hours for 20 days. Susan is curious and wants to know how much of the drug will be in her body over the course of the 20 days. She does some research online and finds out that at the end of 12 hours, about 4% of the drug is still in the body. a. What quantity of the drug is in the body right after the first dose, the second dose, the third dose, the fourth dose? b. When will the total amount of the antibiotic in Susan's body be the highest? What is the amount?					
Building Functions	**F-BF.1b-1** I can represent arithmetic combinations of standard function types algebraically.	What is the recursive formula for 15,12,9,6…..? What is the explicit formula for 15, 12, 9,6….?					
	F-BF.2 I can write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	Logs are stacked in a pile with 24 logs on the bottom row and 15 on the top row. There are 10 rows in all with each row having one more log than the one above it. How many logs are in the stack?					

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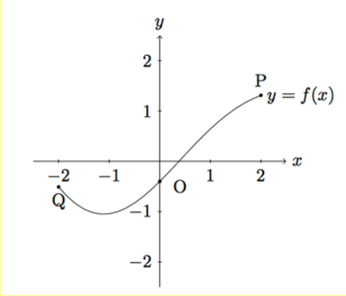
	F-BF.3-2 I can identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs, limiting the function types to polynomial, exponential, logarithmic, and trigonometric functions.	The figure shows the graph of a function *f* whose domain is the interval $-2 \leq x \leq 2$.  a. Sketch the graph of the given function and compare with the graph of *f.* i. $g(x) = f(x) + 2$ ii. $h(x) = -f(x)$ iii. $p(x) = f(x+2)$ www.illustrativemathematics.org					
	F-BF.3-3 I can recognize even and odd functions from their graphs and algebraic expressions for them, limiting the function types to polynomial, exponential, logarithmic, and trigonometric functions.	Determine whether each of these functions is odd, even or neither. Use algebraic methods on all of the functions to justify your conclusions. **a.** $f(x) = 3^x + 3^{-x}$ **b.** $g(x) = 2^x - 2^{-x}$ **c.** $h(x) = x^2 + 4x - 2$ **d.** $j(x) = x^3 - 4x$ www.illustrativemathematics.org					

<table>
<tr><th>Unit</th><th>I Can…</th><th>Example</th><th>🟥</th><th>🟧</th><th>🟨</th><th>🟩</th><th>🟦</th></tr>
<tr><td></td><td>F-BF.Int.2
I can find inverse functions to solve contextual problems.
a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) = $2xx3$ or f(x) =$xx+1xx-1$ for x $\neq$</td><td>The table shows the number of households in the U.S in the years 1998-2004 (www.census.gov)
<table>
<tr><th>Year</th><th>1998</th><th>1999</th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th></tr>
<tr><td>Households In Thousands</td><td>97,107</td><td>98,990</td><td>99,627</td><td>101,018</td><td>102,528</td><td>103,874</td><td>104,705</td></tr>
</table>
a. Find a linear function, f, which models the number of households in the U.S. (in thousands) as a function of the year, t.
b. Write and expression for h^{-1}.
c. Find $h^{-1}(111{,}000)$ and interpret your answer in terms of the number of households.
www.illustrativemathematics.org</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Interpreting Functions</td><td>F-IF.4-2
I can, for an exponential, polynomial, trigonometric, or logarithmic function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; end behavior; symmetries; and periodicity.</td><td>Each of the graphs tells a story about some aspect of the weather: temperature (in degrees Fahrenheit), solar radiation (in watts per square meters), and cumulative rainfall (in inches) measured by sensors in Santa Rosa, CA in February 2012.
a. Give a verbal description of the function represented in each graph. What does each function tell you about the weather in Santa Rosa?
b. Tell a more detailed story using information across several graphs. What are the connections between the graphs?</td><td></td><td></td><td></td><td></td><td></td></tr>
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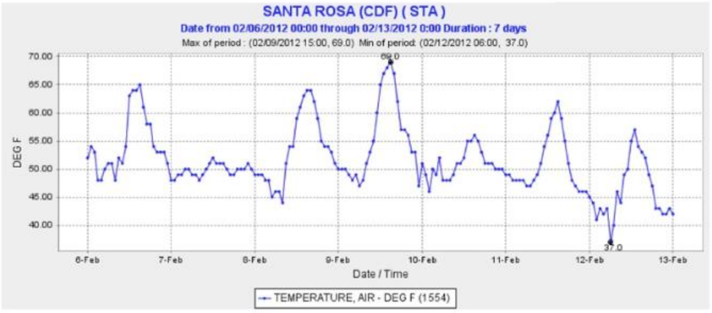
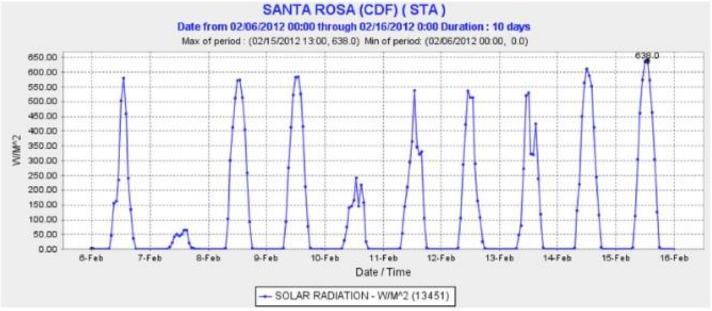
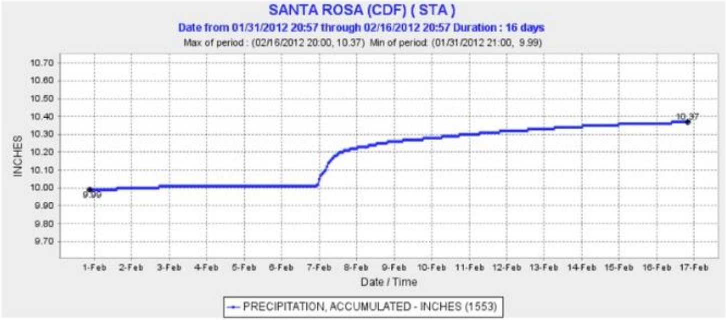
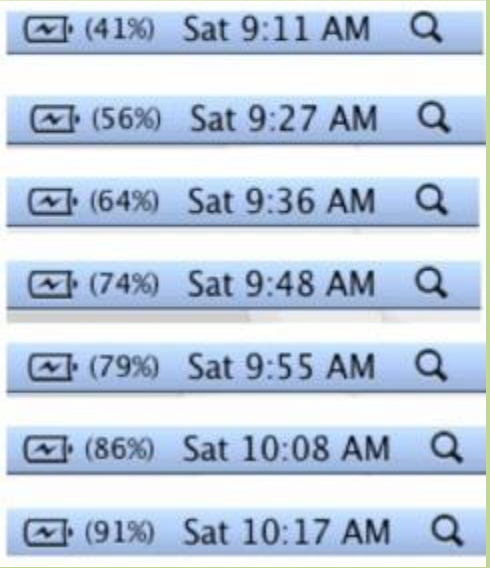
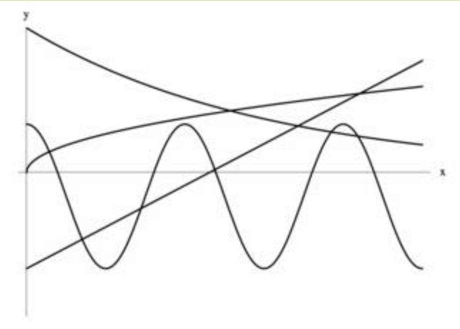
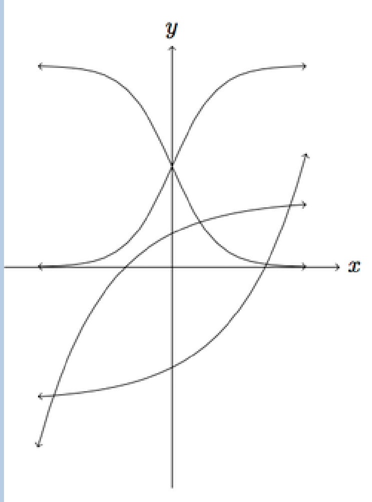
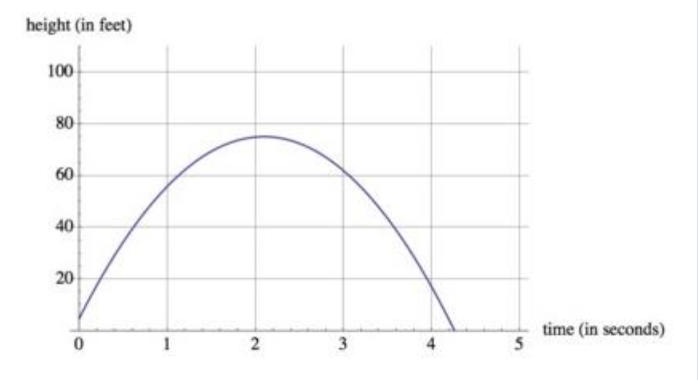
		   www.illustrativemathematics.org					

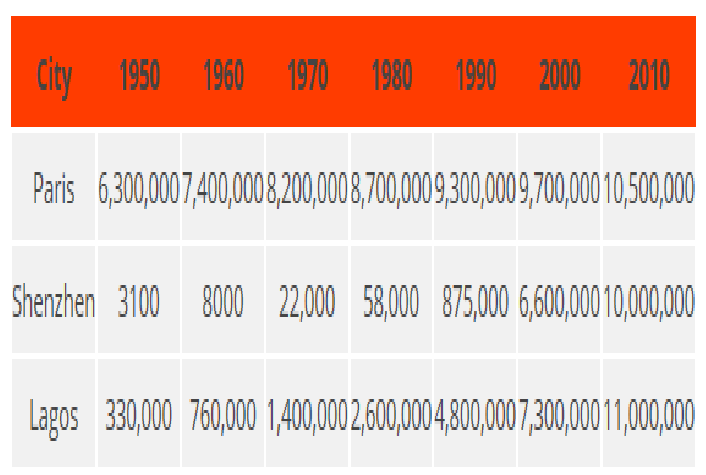
Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
	F-IF.6-2 I can calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval with functions limited to polynomial, exponential, logarithmic and trigonometric functions.	Jerry forgot to plug in his laptop before he went to bed. He wants to take the laptop to his friend's house with a full battery. The pictures below show screenshots of the battery charge indicator after he plugs in the computer.  (41%) Sat 9:11 AM (56%) Sat 9:27 AM (64%) Sat 9:36 AM (74%) Sat 9:48 AM (79%) Sat 9:55 AM (86%) Sat 10:08 AM (91%) Sat 10:17 AM a. When can Jerry expect that is laptop battery is fully charged? b. At 9:27 AM Jerry makes a quick calculation: The battery seems to be charging at a rate of 1 percentage point per minute. So the battery should be fully charges at 10:11 AM. Explain Jerry's calculation. Is his estimate most likely an under- or over-estimate? How does it compare to your prediction?					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
		c. Compare the average rate of change of the battery charging function on the first given time interval and on the last given time interval. What does this tell you about how the battery is charging? www.illustrativemathematics.org					
	F-IF.6-7 I can estimate the rate of change from a graph.	The graphs of four different functions, defined in terms of eight constants: *a*,*b*,*c*,*k*,*m*,*p*,*q*, and *r*. The equations of the functions are: $y = mx + b$ $y = a\cos(x) + c$ $y = qr^x$ kx^p  Match each equation with its graph. Which of the 8 constants are definitely greater than zero but less than one? Which of the 8 constants are definitely negative?					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
	F-IF.7c I can graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. c) Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.	Consider the functions. • $f(x) = \frac{3}{1+e^{-3x}}$ • $g(x) = 1 - \frac{e^{-x}}{2}$ • $k(x) = \frac{3}{1+e^{3x}}$ The graphs of functions shown for$-2 \leq x \leq 2$. Match each function with its graph and explain your choice.  					
	F-IF.7e-1 I can graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. e) Graph exponential functions, showing intercepts and end behavior.	Graph $y = e^{-2x} - 5$. Explain all critical values					

Unit	I Can…	Example	🟥	🟧	🟨	🟩	🟦
	F-IF.7e-2 I can graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. e) Graph logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	Graph cot(*x*) and csc(*x*). Define the period and amplitude for each. What is the amplitude and period for: $y=-2.7\sin 2(x-\pi 4)$					
	F-IF.8b I can write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. b) Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (1.2)^{\frac{t}{10}}$ and classify them as representing exponential growth or decay.	Use mathematics to explain when an exponential function in symbolic for represents exponential growth or decay.					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
	F-IF.9-2 I can compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Function types are limited to polynomial, exponential, logarithmic, and trigonometric functions.	Suppose Brett and Andre each throw a baseball into the air. The height of Brett's baseball is given by $h(t) = -16t^2 + 70t + 6$, where *h* is in feet and *t* is in seconds. The height of Andre's baseball is given by the graph below:  Brett claims that his baseball went higher than Andre's, and Andre says that his baseball went higher. a. Who is right? Use mathematics to explain your answer. b. How long is each baseball airborne? c. Construct a graph of the height of Brett's throw as a function of time on the same set of axes as the graph of Andre's throw, and explain how this can confirm your claims. www.illustrativemathematics.org					

<table>
<tr><th>Unit</th><th>I Can…</th><th>Example</th><th>🟥</th><th>🟧</th><th>🟨</th><th>🟩</th><th>🟦</th></tr>
<tr>
<td>Linear, Quadratic, & Exponential Models</td>
<td>F-LE.2-3
I can solve multi-step contextual problems with degree of difficulty appropriate to the course by constructing linear and/or exponential function models.</td>
<td>The table shows the population estimates for the larger metropolitan areas of Paris, Shenzhen, and Lagos for each decade between 1950 and 2010.

<table>
<tr><th>City</th><th>1950</th><th>1960</th><th>1970</th><th>1980</th><th>1990</th><th>2000</th><th>2010</th></tr>
<tr><td>Paris</td><td>6,300,000</td><td>7,400,000</td><td>8,200,000</td><td>8,700,000</td><td>9,300,000</td><td>9,700,000</td><td>10,500,000</td></tr>
<tr><td>Shenzhen</td><td>3100</td><td>8000</td><td>22,000</td><td>58,000</td><td>875,000</td><td>6,600,000</td><td>10,000,000</td></tr>
<tr><td>Lagos</td><td>330,000</td><td>760,000</td><td>1,400,000</td><td>2,600,000</td><td>4,800,000</td><td>7,300,000</td><td>11,000,000</td></tr>
</table>

a. For each city, decide if the population data can be accurately modeled by a linear, quadratic, and/or exponential function and support your answer.
b. If you found one or more good models for a city population, what predications would those modes make for future decades? Are the predictions reasonable and how do you know?</td>
<td></td><td></td><td></td><td></td><td></td>
</tr>
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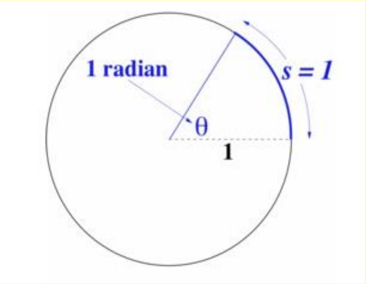
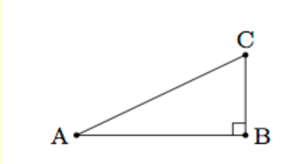
Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
Trigonometric Functions	**F-TF.1** I can understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	An angel of 1 radian is defined to be the angle, in the counterclockwise direction, at the center of a unit circle which spans an arc of length 1. The picture illustrates this definition.  Estimate the angles in radians that correspond to 180 degrees and 360 degrees.					
	F-TF.8-2 I can use the Pythagorean identity $sin^2\theta + cos^2\theta \ = \ 1$ to find sin θ, cos θ, or tan θ, given sin θ, cos θ, or tan θ and the quadrant of the angle.	Prove $\frac{\sin A}{1+\cos A}+\frac{1+\cos A}{\sin A}=\frac{2}{\sin A}$					
	F-Int.1-2 I can, given a verbal description of a polynomial, exponential, rational, trigonometric, or logarithmic functional dependence, write an expression for the function and demonstrate various knowledge and skills articulated in the Functions category in relation to this function.	 **a.** In the triangle pictured show that $\left(\frac{\lvert AB\rvert}{\lvert AC\rvert}\right)^2+\left(\frac{\lvert BC\rvert}{\lvert AC\rvert}\right)^2=1$ **b.** If θ is in the second quadrant and $\sin\theta=\frac{8}{17}$, what can be said about $cos\theta$? Draw a picture and explain.					

<table>
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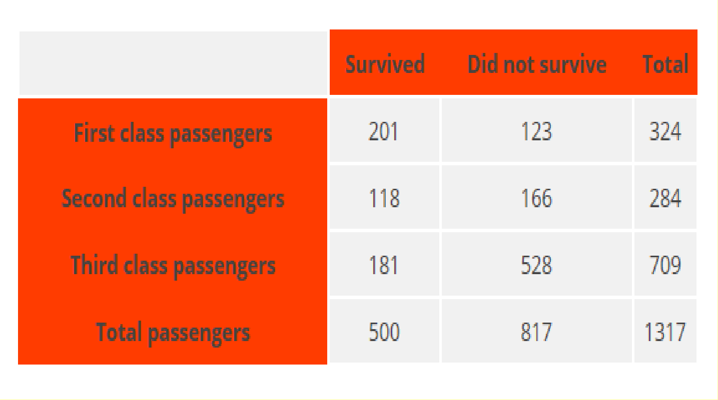
<tr>
<td>Conditional Probability & Rules of Probability</td>
<td>S-CP.Int.1
I can solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in S-CP.</td>
<td>On April 15, 1912, the Titanic struck an iceberg and rapidly sank with only 710 of her 2,204 passengers and crew surviving. Data on survival of passengers are summarized in the table.
http://www.encyclopedia-titanica.org/titanic-statistics.html

<table>
<tr><th></th><th>Survived</th><th>Did not survive</th><th>Total</th></tr>
<tr><td>First class passengers</td><td>201</td><td>123</td><td>324</td></tr>
<tr><td>Second class passengers</td><td>118</td><td>166</td><td>284</td></tr>
<tr><td>Third class passengers</td><td>181</td><td>528</td><td>709</td></tr>
<tr><td>Total passengers</td><td>500</td><td>817</td><td>1317</td></tr>
</table>
a. Calculate the probabilities.
1. If one of the passengers is randomly selected, what is the probability that this passenger was in first class?
2. If one of the passengers is randomly selected, what is the probability that this passenger was in first class and survived?
3. If one of the passengers who survived is randomly selected, what is the probability that this passenger was in first class?
4. If one of the passengers who survived is randomly selected, what is the probability that this passenger was in third class?
b. Why is the answer to a3. Larger than the answer to a4?

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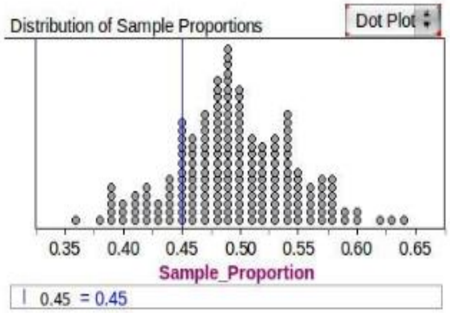
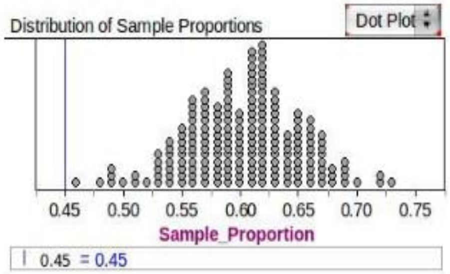
<td></td><td></td><td></td><td></td><td></td>
</tr>
</table>

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
Making Inferences & Justifying Conclusions	**S-IC.2** I can decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?	A random sample of 100 students from a high school resulted in 45% of them favoring a plan to implement block scheduling. Is it plausible that a majority of the students in the school actually favor the block schedule? The plot shows a simulated distribution of sample proportions for samples of size 100 from a population in which 50% of the students favor the plan, and another distribution from a population in which 60% of the students favor the plan. (Each simulation contains 200 runs.) Population proportion 0.5; sample size 100  Population proportion 0.6; sample size 100 					

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
		What do you conclude about the plausibility of a population proportion of 0.50 when the sample proportion is only 0.45? www.illustrativemathematics.org					
	S-IC.3-1 I can recognize the purposes of and differences among sample surveys, experiments, and observational studies.	A student interested in comparing the effect of different types of music on short-term memory conducted the following study: 80 volunteers were randomly assigned to one of two groups. The first group was given five minutes to memorize a list of words while listening to rap music. The second group was given the same task while listening to classical music. The number of words correctly recalled by each individual was then measured, and the results for the two groups were compared. **a.** Is this an experiment or an observational study? Justify your answer. **b.** In the context of this study, explain why it is important that the subjects were randomly assigned to the two experimental groups (rap music and classical music). www.illustrativemathematics.org					

Algebra II

Unit	I Can…	*Example*	🟥	🟧	🟨	🟩	🟦
Interpreting Categorical and Quantitative Data	**S-ID.4** I can use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	Suppose the SAT mathematics scores for a particular year are approximately normally distributed with a mean of 510 and a standard deviation of 100. **a.** What is the probability that a randomly selected score is greater than 610? **b.** Between 410 and 710? **c.** If a student is known to score 750, what is the student's percentile score? www.illustrativemathematics.org					
	S-ID.6a-1 I can solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in S-ID.6a, excluding normal distributions and limiting function fitting to exponential functions.						
	S-ID.6a-2 I can solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in S-ID.6a, excluding normal distributions and limiting function fitting to trigonometric functions.						