TRG Curriculum Pacing Guide
Algebra II

Trimester 1

September

Course Standards	School Improvement Standards	Classroom Intervention Standards
POLYNOMIAL, RATIONAL, AND RADICAL RELATIONSHIPS ▪ **Reason quantitatively and use units to solve problems: N-Q.2** o This standard will be assessed in Algebra II by ensuring that some modeling tasks (involving Algebra II content or securely held content from previous grades and courses) require the student to create a quantity of interest in the situation being described (i.e., this is not provided in the task). For example, in a situation involving periodic phenomena, the student might autonomously decide that amplitude is a key variable in a situation, and then choose to work with peak amplitude. ▪ **Perform arithmetic operations with complex numbers: N-CN.1, N-CN.2** ▪ **Use complex numbers in polynomial identities and equations: N-CN.7** ▪ **Interpret the structure of expressions: A-SSE.2** o In Algebra II, tasks are limited to polynomial, rational, or exponential expressions. Examples: see $x4 - y4$ as $(x2)2 - (y2)2$, thus recognizing it as a difference of squares that can be factored as $(x2 - y2)(x2 + y2)$. In the equation $x2 + 2x + 1 + y2 = 9$, see an opportunity to rewrite the first three terms as $(x+1)2$, thus recognizing the equation of a circle with radius 3 and center (– 1, 0). See $(x2 + 4)/(x2 + 3)$ as $((x2+3) + 1)/(x2+3)$, thus recognizing an opportunity to write it as $1 + 1/(x2 + 3)$. Can include the sum or difference of cubes, and factoring by grouping. ▪ **Understand the relationship between zeroes and factors of polynomials: A-APR.2, A-APR.3** o Include problems that involve interpreting the Remainder Theorem from graphs and in problems that require long division. o In Algebra II, tasks include quadratic, cubic, and quartic polynomials and polynomials for which factors are not		

provided. **Use polynomial identities to solve problems: A-APR.4**		
October		
Course Standards	**School Improvement Standards**	**Classroom Intervention Standards**
▪ **Rewrite rational expressions: A-APR.6** o Include rewriting rational expressions that are in the form of a complex fraction. ▪ **Understand solving equations as a process of reasoning and explain the reasoning: A-REI.1, A-REI.2** o In Algebra II, tasks are limited to simple rational or radical equations. ▪ Solve equations and inequalities in one variable: A-REI.4b o In Algebra II, in the case of equations having roots with nonzero imaginary parts, students write the solutions as a ± bi where a and b are real numbers. ▪ **Solve systems of equations: A-REI.6, A-REI.7** o In Algebra II, tasks are limited to 3x3 systems. ▪ Analyze functions using different representations: F-IF.7c. Translate between the geometric description and the equations for a conic section: G-GPE.2		
November		
Course Standards	**School Improvement Standards**	**Classroom Intervention Standards**
TRIGONOMETRIC FUNCTIONS ▪ **Extend the domain of trigonometric functions using the unit circle: F-TF.1, F-TF.2** o Also extend trigonometric functions to their reciprocal functions. ▪ Model periodic phenomena with trigonometric functions: F-TF.5 o Including specified phase shift. Prove and apply trigonometric identities: F.TF.8		

Trimester 3		
March		
Course Standards	**School Improvement Standards**	**Classroom Intervention Standards**
FUNCTIONS ▪ **Extend the properties of exponents to rational exponents: N-RN.1, N-RN.2** o Including expressions where either base or exponent may contain variables. ▪ Reason quantitatively and use units to solve problems: N-Q.2b o This standard will be assessed in Algebra II by ensuring that some modeling tasks (involving Algebra II content or securely held content from previous grades and courses) require the student to create a quantity of interest in the situation being described (i.e., this is not provided in the task). For example, in a situation involving periodic phenomena, the student might autonomously decide that amplitude is a key variable in a situation, and then choose to work with peak amplitude. ▪ Write expressions in equivalent forms to solve problems: A-SSE.3, A-SSE.4 o Tasks have a real-world context. As described in the standard, there is an interplay between the mathematical structure of the expression and the structure of the situation such that choosing and producing an equivalent form of the expression reveals something about the situation. In Algebra II, tasks include exponential expressions with rational or real exponents.		

○ This standard includes using the summation notation symbol. ▪ Create equations that describe numbers or relationships: A-CED.1 ○ Tasks have a real-world context. In Algebra II, tasks include exponential equations with rational or real exponents, rational functions, and absolute value functions. ▪ Represent and solve equations and inequalities graphically: A-REI.11 In Algebra II, tasks may involve any of the function types mentioned in the standard.		
April		
Course Standards	**School Improvement Standards**	**Classroom Intervention Standards**
▪ Understand the concept of a function and use function notation: F-IF.3 ○ This standard is Supporting Content in Algebra II. This standard should support the Major Content in F-BF.2 for coherence. ▪ Interpret functions that arise in applications in terms of the context: F-IF.4, F-IF.6 ○ Tasks have a real-world context. In Algebra II, tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. ▪ Analyze functions using different representations: F-IF.7e, F-IF.8b, F-IF.9 ○ In Algebra II, tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. ▪ Build a function that models a relationship between two quantities: F-BF.1, F-BF.2 ▪ Build new functions from existing functions: F-BF.3,		

F-BF.4a ○ In Algebra II, tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. Tasks may involve recognizing even and odd functions. ▪ Construct and compare linear, quadratic and exponential models and solve problems: F-LE.2, F-LE.4 ○ In Algebra II, tasks will include solving multi-step problems by constructing linear and exponential functions. ○ Students learn terminology that logarithm without a base specified is base 10 and that natural logarithm always refers to base *e*. ▪ Interpret expressions for functions in terms of the situation they model: F-LE.5 Tasks have a real-world context. In Algebra II, tasks include exponential functions with domains not in the integers.		
May		
Course Standards	**School Improvement Standards**	**Classroom Intervention Standards**
INFERENCES AND CONCLUSIONS FROM DATA: ▪ Reason quantitatively and use units to solve problems: N-Q.2 ▪ Summarize, represent and interpret data on a single count or measurement variable: S-ID.4 ▪ Summarize, represent, and interpret data on two categorical and quantitative variables: S-ID.6a ▪ Understand and evaluate random processes underlying statistical experiments: S-IC.1, S-IC.2 Make inferences and justify conclusions from sample surveys, experiments, and observational studies: S-IC.3, S-IC.4, S-IC.5, S-IC.6		
June		

Course Standards	School Improvement Standards	Classroom Intervention Standards
▪ Understand independence and conditional probability and use them to interpret data: S-CP.1, S-CP.2, S-CP.3, S-CP.4, S-CP.5 Use the rules of probabilities of compound events in a uniform probability model: S-CP.6, S-CP.7		

TRG Algebra II
Curriculum Guide

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND: SSE	MONTH(S) TAUGHT:

CODE:

A.SSE.2

Description: A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).

Unpacked Standard:
Rewrite algebraic expressions in different equivalent forms such as factoring or combining like terms. Use factoring techniques such as common factors, grouping, the difference of two squares, the sum or difference of two cubes, or a combination of methods to factor completely. Simplify expressions including combining like terms, using the distributive property and other operations with polynomials.

ACT/Anchor Standard: Expressions, Equations, & Inequalities:
Combine like terms (e.g., 2x + 5x)
Add and subtract simple algebraic expressions
Multiply two binomials
Add, subtract, and multiply polynomials
Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)
Manipulate expressions and equations

Board Objective: How do I interpret the structure of expressions to become a better problem solver?

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Students need to be able to: • Know the difference between an algebraic expression and a polynomial • Identify clues in the structure of the expressions (e.g., like terms, common factors, difference of squares, perfect squares) • Explain why equivalent expressions are equivalent • Apply methods for performing operations with algebraic expressions • Apply methods for factoring algebraic expressions (e.g., recognize GCF, rewrite using factoring, factor by GCF, factor difference of squares, factor trinomials, factor by grouping)	In Algebra II, tasks are limited to polynomial, rational, or exponential expressions. Examples: see $x4 - y4$ as $(x2)2 - (y2)2$, thus recognizing it as a difference of squares that can be factored as $(x2 - y2)(x2 + y2)$. In the equation $x2 + 2x + 1 + y2 = 9$, see an opportunity to rewrite the first three terms as $(x+1)2$, thus recognizing the equation of a circle with radius 3 and center $(– 1, 0)$. See $(x2 + 4)/(x2 + 3)$ as $((x2+3) + 1)/(x2+3)$, thus recognizing an opportunity to write it as $1 + 1/(x2 + 3)$. Can include the sum or difference of cubes, and factoring by grouping. **Clarifying Objectives**: Students rewrite algebraic expressions by combining like terms or factoring to reveal equivalent forms of the same expression. In English, we have many different ways of saying the same thing. "Stop that!" and "Stop eating that!" and "Stop eating my sandwich!" all mean the same thing, but it's important to be able to know which one to use. Well, if your sandwich is being eaten, then any of those will probably work. Math works much the same way. Writing mathematical expressions in different ways is incredibly important, especially in algebra. It's not about	Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables. Construction, Interpretation, and Manipulation of Expressions: Know the definitions and properties of exponents and roots transition fluently between them, and apply them in algebraic expressions. Students should extract the greatest common factor (whether a constant, a variable, or a combination of each). If the remaining expression is quadratic, students should factor the expression further.

Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem	redundancy; it's about simplicity. And about keeping a firm grip on that sandwich of yours. Students should be able to convert mathematical expressions to alternative but equivalent forms by factoring. This is important when students want to explain certain properties of an expression or the quantity which the expression represents, solve equations involving mathematical expressions, or simplify complex expressions. They might not want to at first, but if you tell them it's on the chapter test, they'll most likely be very interested. In general, students should follow these rules: ▪ Determine if there is a greatest common factor in the expression. You typically want to factor that out first, as it leaves a simpler expression to concentrate on in subsequent steps. ▪ Determine if it is possible to use the grouping technique. ▪ If the expression is a quadratic, put it in standard form first. ▪ Examine the form of the expression and determine if one of the special forms—the difference of two squares or the perfect square trinomial—applies. If so, apply the rules given previously for writing the factored form. ▪ If the quadratic is not a special form, use the general method for factoring quadratics. Factoring takes a lot of practice, but it is probably the single most important skill students will develop in math. It is critical to just about every topic in higher levels of math, so it is worthwhile to spend a fair amount of time developing this skill. Once students start getting the hang of it, many of them will be able to just "see" the factors. Encourage them to always look for patterns, to pay attention to the individual pieces of the expressions they get and how they appear to relate to the pieces of the original expression. http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-2.html	CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:

http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	Linear equation Quadratic equation System of linear equations Absolute values Algebraic expression Evaluate expression Pattern Variable Coefficient Weighted average Equation Inequality Least squares regression line Slope Regression line
ESSENTIAL QUESTIONS:	
HOW DO YOU INTERPRET EXPRESSIONS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND: SSE	MONTH(S) TAUGHT:

CODE:

A.SSE.3

Description: A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
a. Factor a quadratic expression to reveal the zeros of the function it defines.
b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as (1.151/12)12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Connections: 9-10.WHST.1c; 11-12.WHST.1c

Unpacked Standard:
A.SSE.3a Write expressions in equivalent forms by factoring to find the zeros of a quadratic function and explain the meaning of the zeros. Given a quadratic function explain the meaning of the zeros of the function. That is if f(x) = (x – c) (x – a) then f(a) = 0 and f(c) = 0. Given a quadratic expression, explain the meaning of the zeros graphically. That is for an expression (x – a) (x – c), a and c correspond to the x-intercepts (if a and c are real).

A.SSE.3b Write expressions in equivalent forms by completing the square to convey the vertex form, to find the maximum or minimum value of a quadratic function, and to explain the meaning of the vertex.

A.SSE.3c Use properties of exponents (such as power of a power, product of powers, power of a product, and rational exponents, etc.) to write an equivalent form of an exponential function to reveal and explain specific information about its approximate rate of growth or decay.

ACT/Anchor Standard:
Numbers: Concepts & Properties:
Apply rules of exponents
Expressions, Equations, & Inequalities:
Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)
Manipulate expressions and equations
Solve quadratic equations

Board Objective: I can write expressions in equivalent forms to solve problems and to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Students need to be able to: • Factor a quadratic	Tasks have a real-world context. As described in the standard, there is an interplay between the mathematical structure of the expression and the	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible).

expression • Identify the zeros (roots, x-intercepts, solutions) by factoring the quadratic expression • Explain the meaning of the zeros as it relates to the context of the problem (zeros are the x-values that yield a y-value of zero) Before Quick Write During Bell Ringers Quiz Assignment After Exit problem Unit Test	structure of the situation such that choosing and producing an equivalent form of the expression reveals something about the situation. In Algebra II, tasks include exponential expressions with rational or real exponents. **Clarifying Objectives**: Students factor quadratic expressions and find the zeros of the quadratic function they represent. Zeros are the x-values that yield a y-value of 0. Students should also explain the meaning of the zeros as they relate to the problem. *At this level, limit to quadratic expressions of the form $ax^2 + bx + c$.* Solve linear and quadratic equations and inequalities including systems of up to three linear equations with three unknowns. Justify steps in the solution, and apply the quadratic formula appropriately. Relate the number of real solutions of a quadratic equation to the graph of the associated quadratic function Your students should be gaining fluency in mathematics, and be able to write and rewrite expressions. The spells of nausea, hyperventilation, and paranoia surrounding the beautiful language of mathematics should have subsided by now. If they haven't, you may want to consult the school nurse. Rather than rewriting expressions for the fun of it (and it is fun, isn't it?), students should understand what these different expressions can tell us about the quantities they represent. These mathematical expressions can tell us the zeros (or roots or x-intercepts) and the maximum and minimum values of a function, and have plenty of other applications in the real world. Most of them involving money. http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3.html	Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/ Math Tutorial: http://www.mathwords.com/m/multiplicative_inverse_of_a_number.htm Algorithms Activity: http://www.hsor.org/modules.cfm?name=Jurassic_Oil Algebraic Expressions Review: http://people.hofstra.edu/Stefan_Waner/RealWorld/tut_alg_review/framesA_3B.html Interactive Function Grapher: http://www.shodor.org/interactivate/activities/FunctionFlyer/	• Factor (verb) • Quadratic expression • Quadratic equation • Zeros • Roots • X-intercepts • Solutions • Perfect-square trinomial • Function

Rate of Change Lesson: • http://illuminations.nctm.org/LessonDetail.aspx?ID=U136	
ESSENTIAL QUESTIONS:	
WHAT ARE FUNCTIONS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND: SSE	MONTH(S) TAUGHT:
CODE: **A.SSE.4**	Description: A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments. Connection: 11-12.RST.4 Unpacked Standard: A.SSE.4 Develop the formula for the sum of a finite geometric series when the ratio is not 1. A.SSE.4 Use the formula to solve real world problems such as calculating the height of a tree after n years given the initial height of the tree and the rate the tree grows each year. Calculate mortgage payments.		
	ACT/Anchor Standard: Numbers: Concepts & Properties: Apply rules of exponents Expressions, Equations, & Inequalities: Factor simple quadratics (e.g., the difference of squares and perfect square trinomials) Manipulate expressions and equations Solve quadratic equations		
	Board Objective: I can write expressions in equivalent forms to solve problems and to become a better problem solver.		

ASSESSMENTS:	CONCEPT NOTES	STRATEGIES
Sample Formative Assessment: Skill-Based Task:	This standard includes using the summation notation symbol.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible).

Write 0.3 repeating as an infinite geometric series. Represent this series using summation notation. Find the sum. Problem Task: • You are starting to save in a fixed rate savings account that earns 6% interest annually but is compounded monthly. Each month you deposit $100. Write a formula for the total money saved after n months. Write a formula for the total money earned after n months. Before Quick Write During Bell Ringers Quiz Assignment After Exit problem Unit Test	Although students may not know it, they already know a lot about sequences and series. Not only are sequences and series on TV, in music, and all over the Internet, they were also taught between nap time and making those dried macaroni picture frames. You could have a sequence as easy as one, two, three. In mathematics, a sequence is a bunch of numbers listed one after the other. In many cases, it is possible to determine a particular member of a sequence simply from its location, just like when counting natural numbers. That sequence starts with the number 1 and every other member of the sequence can be found by taking the previous member of the sequence and adding 1 to it. Students should know the difference between an arithmetic sequence and a geometric sequence. In arithmetic sequences, successive members have a common difference. That is, the difference between each member and the one before it is some constant value. In geometric sequences, all numbers have a common ratio, meaning that the quotient of each member and the one before it is some constant value. For detailed examples visit http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-4.html **Example:** In February, the Bezanson family starts saving for a trip to Australia in September. The Bezanson's expect their vacation to cost $5375. They start with $525. Each month they plan to deposit 20% more than the previous month. Will they have enough money for their trip? $(x-1)(x+1)$, and $(x-1)(x^3+x^2+x+1)$. Discuss how this leads to the general formula for the sum of a geometric series. Use fractals (Sierpenski's Gasket, Koch Snowflake) to	Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

	generate sequences and series.	
RESOURCES		VOCABULARY
NCTM: Navigating through Geometry in Grades 9-12 (Chapter 4, "Visualizing Limits in Our World) http://www.tncurriculumcenter.org/concept/geometric+sequence Math Tutorial: http://www.mathwords.com/m/multiplicative_inverse_of_a_number.htm Algorithms Activity: http://www.hsor.org/modules.cfm?name=Jurassic_Oil Algebraic Expressions Review: http://people.hofstra.edu/Stefan_Waner/RealWorld/tut_alg_review/framesA_3B.html Interactive Function Grapher: http://www.shodor.org/interactivate/activities/FunctionFlyer/ Rate of Change Lesson: http://illuminations.nctm.org/LessonDetail.aspx?ID=U136		summation notation, Σ, sequence, series, infinite, finite, term
ESSENTIAL QUESTIONS:		
WHAT ARE FUNCTIONS?		

GRADE: Algebra II	SUBJECT: Math	STRAND: APR	MONTH(S) TAUGHT:
CODE: **A.APR.2**	Description: A.APR.2 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). Unpacked Standard: A.APR.2 Understand and apply the Remainder Theorem. A.APR.2 Understand how this standard relates to A.SSE.3a. A.APR.2 Understand that a is a root of a polynomial function if and only if x-a is a factor of the function.		
	ACT/Anchor Standard: Expressions, Equations, & Inequalities: Manipulate expressions and equations Write equations and inequalities that require planning, manipulating, and/or solving		
	Board Objective: I know and can use the remainder theorem.		

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Sample Formative Assessment Tasks: **Skill-Based Task:** Using the Remainder Theorem, decide whether $(x-5)$ and $(x+2)$ are factors of the polynomial $f(x)=2x^3-5x^2-28x+15$. **Problem Task:** If 1 is a root of $p(x)$, explain why $p(x)$ has a factor of $(x-1)$. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product	Include problems that involve interpreting the Remainder Theorem from graphs and in problems that require long division. Connect the factors of a polynomial to the roots of an equation. Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables. Transform exponential and logarithmic expressions into equivalent forms using the properties of exponents and logarithms, including the inverse relationship between exponents and logarithms. Associate a given equation with a function whose zeros are the solutions of the equation. Before introducing remainders of polynomials to your	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your

Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	students, be sure they remember what a remainder is. No, not a reindeer. A remainder. For example, tell them to divide 13 by 4. If they've gotten this far in math, this really shouldn't be a problem for them. Most of them will give you the answer 3.25. Instead, backtrack a few years of schooling and tell them to write their answer as "3 remainder 1." It's the same thing, only for third graders. If we divide two integers, sometimes they make another integer (6 ÷ 2 = 3), and other times they have remainders (13 ÷ 4 = 3 remainder 1). A remainder of 0 means that the second number is a factor of first number. For instance, 2 is a factor of 6 because we can multiply 2 by an integer to get 6. Once they've gotten over the intense déjà-vu, slowly and gently explain to them that polynomials are the same way. If dividing polynomial p(x) by x – a has a remainder of 0, we'll know that x – a is a factor of p(x). In other words, p(x) = q(x) × (x – a) where q(x) is a polynomial or an integer. Students should know how to perform all these calculations and rearrangements. For their answers to be at least somewhat reasonable, they should be comfortable with factoring polynomials, finding remainders, and of course, division. You'd think that last part goes without saying, but you never know. If students find these tasks particularly confusing, we suggest practicing with integers. That way, students can perform these same calculations within their comfort zones. Plus, they can check their answers, too. http://www.shmoop.com/common-core-standards/ccss-hs-a-apr-2.html	topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES		VOCABULARY
Illustrativemathematics.org http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/		Linear Functions Remainder Theorem, factor
ESSENTIAL QUESTIONS:		
WHAT DOES THE DEGREE OF A POLYNOMIAL TELL YOU ABOUT ITS RELATED POLYNOMIAL FUNCTION? FOR A POLYNOMIAL FUNCTION, HOW ARE FACTORS, ZEROS AND X-INTERCEPTS RELATED? FOR A POLYNOMIAL FUNCTION, HOW ARE FACTORS AND ROOTS RELATED?		

GRADE: Algebra II	SUBJECT: Math	STRAND: APR	MONTH(S) TAUGHT:

CODE: **A.APR.3**	Description: A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. Unpacked Standard: A.APR.3 Find the zeros of a polynomial when the polynomial is factored. A.APR.3 Use the zeros of a function to sketch a graph of the function.
	ACT/Anchor Standard: Graphical Representations: Interpret and use information from graphs in the coordinate plane Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$
	Board Objective: I can become a better problem solver by understanding the relationship between zeros and factors of polynomials.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Sample Problem Task: Given a fourth degree polynomial, how could you have: Zero real roots? One real root? · Two real roots? Three real roots? Four real roots? Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product	In Algebra II, tasks include quadratic, cubic, and quartic polynomials and polynomials for which factors are not provided. Using graphing calculator applications to explore expanded and factored forms of multiple polynomials. Use a number line model to show where the function is positive, negative, or equal to zero. Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables. Transform exponential and logarithmic expressions into equivalent forms using the properties of exponents and logarithms, including the inverse relationship between exponents and logarithms. Associate a given equation with a function whose zeros are the	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with

Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	solutions of the equation. In plain English, this standard is all about factoring polynomials and finding their zeros. It's about time too, because it can be frustrating dealing with students who claim that $x^3 - 10x^2 - 2x + 24$ has 1 zero because of $10x^2$. So frustrating that you may or may not want to quit this teaching gig and get a job at the local circus. At least they'd take you more seriously there. First, your students should know that finding the zeros of a polynomial doesn't mean counting how many zeros they can find. That's not algebra. That's counting. The **zeros** of a polynomial are the x values when we set the polynomial itself to equal zero. In other words, when we plug in any of the zeros of a polynomial in for x, our answer should be 0. So the zeros of $x^3 - 10x^2 - 2x + 24$ are the x values that make the equation $x^3 - 10x^2 - 2x + 24 = 0$ true. Why are these zero values important? On the coordinate plane, they're the places where the function crosses the x-axis. The zeros of the polynomial (also called the solutions or "roots") are the x-intercepts of the graph. To find the zeros, students should factor polynomials into linear factors (where x is only to the first power). Then, setting each linear factor equal to 0 and solving for the variable will give us the x-intercepts, which can be used to graph the function. Students should also have a rough idea of how different polynomials should look when graphed. Linear functions make lines, quadratic functions make parabolas, and so on. They don't have to know exactly which term affects which aspect of the graph, but their answers shouldn't look like a game of connect-the-dots. http://www.shmoop.com/common-core-standards/ccss-hs-a-apr-3.html	varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/		Remainder Theorem
ESSENTIAL QUESTIONS:		
HOW DO POLYNOMIAL RELATIONSHIPS COMPARE TO NUMERICAL RELATIONSHIPS?		

GRADE: Algebra II	SUBJECT: Math	STRAND: APR	MONTH(S) TAUGHT:

CODE:

A.APR.4

Description: A.APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity (x2 + y2)2 = (x2 – y2)2 + (2xy)2 can be used to generate Pythagorean triples.

Unpacked Standard:

A.APR.4 Understand that polynomial identities include but are not limited to the product of the sum and difference of two terms, the difference of two squares, the sum and difference of two cubes, the square of a binomial, etc .

A.APR.4 Prove polynomial identities by showing steps and providing reasons.

A.APR.4 Illustrate how polynomial identities are used to determine numerical relationships such as $25^2 = (20+5)^2 = 20^2 + 2 \bullet 20 \bullet 5 + 5^2$

ACT/Anchor Standard:
Expressions, Equations, & Inequalities:
Manipulate expressions and equations

Board Objective: I can use polynomial identities to solve problems to develop my critical thinking skills.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use	Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity (x2 + y2)2 = (x2 – y2)2 + (2xy)2 can be used to generate Pythagorean triples. Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables. Transform exponential and logarithmic expressions into equivalent forms using the properties of exponents and logarithms, including the inverse relationship between exponents and logarithms. Associate a given equation with a function whose zeros are the solutions of the equation. With the increase in technology and this huge new thing called the Internet, identity theft has become a worldwide problem. For this reason, it is paramount to	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will

strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	keep important information such as addresses and telephone numbers as private as possible when online. If not, you might have thieves coming to your home and stealing your polynomial identities. Sure, *your* identity should be kept safe too, but we were talking more about polynomial identities. A **polynomial identity** is just a true equation, often generalized so that it can apply to more than one situation. For instance, $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ is true for any x and y. But how can we be sure that's true unless we prove it? Students should be able to prove identities by showing that one side of an equation is equal to the other. That just takes the same skills they use to organize equations and expressions. They can leave their room-cleaning skills at home, since we all know how organized *those* are. To prove polynomial identities, students can either work from one side of the equation to try to derive the other side, or can work from both sides to get the same thing. Both are just fine as long as both sides end up being exactly the same. The goal is to make both sides identical. Students should also understand the use of certain identities. Sometimes, memorizing an identity is quicker than working out the algebra longhand, and other times the identity applies to a particular context. http://www.shmoop.com/common-core-standards/ccss-hs-a-apr-4.html	reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES		VOCABULARY

http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	Polynomial identity

ESSENTIAL QUESTIONS:
WHAT ARE LINEAR FUNCTIONS? WHAT ARE POLYNOMIALS? WHAT DOES THE DEGREE OF A POLYNOMIAL TELL YOU ABOUT ITS RELATED POLYNOMIAL FUNCTION? FOR A POLYNOMIAL FUNCTION, HOW ARE FACTORS, ZEROS AND X-INTERCEPTS RELATED? FOR A POLYNOMIAL FUNCTION, HOW ARE FACTORS AND ROOTS RELATED?

GRADE: Algebra II	SUBJECT: Math	STRAND: CED	MONTH(S) TAUGHT:

CODE:

A.CED.1

Description: A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

A.CED.1 Create linear, quadratic, rational and exponential equations and inequalities in one variable and use them in a contextual situation to solve problems.

Unpacked Standard:
A.CED.1 Create linear, quadratic, rational and exponential equations and inequalities in one variable and use them in a contextual situation to solve problems.

ACT/Anchor Standard:
Expressions, Equations, & Inequalities:
Evaluate algebraic expressions by substituting integers for unknown quantities
Solve routine first-degree equations
Perform straightforward word-to-symbol translations
Solve real-world problems using first-degree equations
Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)
Identify solutions to simple quadratic equations
Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)
Solve first-degree inequalities that do not require reversing the inequality sign
Write expressions, equations, and inequalities for common algebra settings
Solve linear inequalities that require reversing the inequality sign
Solve quadratic equations
Write equations and inequalities that require planning, manipulating, and/or solving
Solve simple absolute value inequalities

Graphical Representations:
Locate points in the coordinate plane
Match linear graphs with their equations
Interpret and use information from graphs in the coordinate plane
Match number line graphs with solution sets of linear inequalities
Match number line graphs with solution sets of simple quadratic inequalities

Board Objective: I can create equations that describe numbers or relationships to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES	STRATEGIES
Students need to be able to: •Identify the variables and quantities represented in a real-world problem. •Determine the best model for the real-world problem (linear equation, linear inequality, exponential equation) •Write the equation or inequality that best models the problem •Solve the equation or inequality •Interpret the solution in the context of the problem Tasks have a real-world context. In Algebra II, tasks include exponential equations with rational or real exponents, rational functions, and absolute value functions.	From contextual situations, write equations and inequalities in one variable and use them to solve problems. Include linear and exponential functions. At this level, focus on linear and exponential functions. Write equations and inequalities with one or two variables to represent mathematical or applied situations, and solve. Associate a given equation with a function whose zeros are the solutions of the equation. Solve linear and quadratic equations and inequalities including systems of up to three linear equations with three unknowns. Justify steps in the solution, and apply the quadratic formula appropriately. Write equations and inequalities with one or two variables to represent mathematical or applied situations, and solve. Solve linear and quadratic equations and inequalities including systems of up to three linear equations with three unknowns. Justify steps in the solution, and apply the quadratic formula appropriately. Solve absolute value equations and inequalities, and justify steps in the solution. Solve polynomial equations and equations involving rational expressions, and justify steps in the solution. Relate the number of real solutions of a quadratic equation to the graph of the associated quadratic function. Explain the exponential relationship between a number and its base 10 logarithm and use it to relate rules of logarithms to those of exponents in expressions involving numbers. Lines and Linear Functions: Write the symbolic forms of linear functions	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples.

	(standard, point-slope, and slope-intercept) given appropriate information, and convert between forms. Equations can represent real world and mathematical problems. Include equations and inequalities that arise when comparing the values of two different functions, such as one describing linear growth and one describing exponential growth.	Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES	VOCABULARY
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	Linear Function Exponential Function Equations Inequalities Quadratic Functions Rational Functions Exponential Functions

ESSENTIAL QUESTIONS:

HOW DO YOU CREATE EQUATIONS THAT DESCRIBE NUMBERS OR RELATIONSHIPS?

GRADE: Algebra II	SUBJECT: Math	STRAND: REI	MONTH(S) TAUGHT:

CODE: **A.REI.1**	Description: A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. Unpacked Standard A.REI.1 Assuming an equation has a solution, construct a convincing argument that justifies each step in the solution process. Justifications may include the associative, commutative, and division properties, combining like terms, multiplication by 1, etc.
	ACT/Anchor Standard: Expressions, Equations, & Inequalities: Manipulate expressions and equations
	Board Objective: I can use expressions and equations to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Students need to be able to: • Apply order of operations and inverse operations to solve equations • Construct an argument to justify each step in solving an equation Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic	**In Algebra II, tasks are limited to simple rational or radical equations.** **Clarifying Objectives**: Relate the concept of equality to the concrete representation of the balance of two equal quantities. Properties of equality are ways of transforming equations while still maintaining equality/balance. Assuming an equation has a solution, construct a convincing argument that justifies each step in the solution process with mathematical properties. A.REI.1: Properties of operations can be used to change expressions on either side of the equation to equivalent expressions. In addition, adding the same term to both sides of an equation or multiplying both sides by a non-zero constant produces an equation with the same solutions. Other operations, such as squaring both sides, may produce equations that have extraneous solutions. Note: Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses. Who was it that said, "A journey of a thousand miles begins with a single step"? Whoever it was, they probably weren't thinking about algebra when they coined that gem. To many students, solving an algebraic equation may feel like a journey of a thousand miles. Before students begin with their single step, they should probably	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach.

thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	get a compass or something. Students should be able to figure out the logical next step in solving an equation using the previous step. Sounds simple, but it takes more than just putting one foot in front of the other. Knowing that whatever is done to one side of the equation must be done to the other is a good start, but that doesn't tell them what to do. Ideally, students should not be memorizing a set of rules and procedures and using them to solve equations. They should understand how the next step in solving an equation can be logically derived from the previous step, but there is a general format for how to get started on their algebraic journey. When we solve an equation, it's usually a good idea to get the variable we want on one side of the equal sign. Then, we do what we can to simplify it as much as we can. For example, let's solve the equation $x^2 - 3x - 7 = 2x + 17$. Subtracting $2x + 17$ from both sides gets all our x's on one side of the equation. That's a good place to start. $x^2 - 3x - 7 - (2x + 17) = 2x + 17 - (2x + 17)$ $x^2 - 5x - 24 = 0$ We also took the opportunity to simplify by combining like terms. Since the equation we have is a quadratic equation, we can factor it into the product of two linear terms. $(x - 8)(x + 3) = 0$ This product will equal 0 when either $x - 8$ or $x + 3$ is equal to 0, so we can solve it by setting each of them to 0. As a result, $x = 8$ and -3. If students are really struggling, we suggest starting simple. Give them easier linear equations and slowly work your way to more complex ones. Point out patterns in equations, make sure they know the quadratic formula, and remind them of helpful factoring tricks. Most of all, get them to practice. It's difficult to take even the first step of a journey	Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

	if you can't walk. http://www.shmoop.com/common-core-standards/ccss-hs-a-rei-1.html	

RESOURCES:	VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	• Order of operations, Order of inverse operations, absolute value, coefficients, constant, equations, exponents, factor, inequalities, linear, parts of expressions, problems, properties of, exponents, quadratic, radical expressions, rational exponents, solution method, terms, variable

ESSENTIAL QUESTIONS:
HOW DO EXPRESSIONS AND EQUATIONS HELP US MODEL AND SOLVE PROBLEMS?

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND: REI	MONTH(S) TAUGHT:

CODE: **A.REI.4A**	Description: A.REI.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x – p)2 = q that has the same solutions. Derive the quadratic formula from this form. Unpacked Standard A.REI.4a Transform a quadratic equation written in standard form to an equation in vertex form (x - p) = q 2 by completing the square. A.REI.4a Derive the quadratic formula by completing the square on the standard form of a quadratic equation.
	ACT/Anchor Standard: Numbers: Concepts & Properties: Exhibit some knowledge of the complex numbers Expressions, Equations, & Inequalities: Identify solutions to simple quadratic equations Factor simple quadratics (e.g., the difference of squares and perfect square trinomials) Manipulate expressions and equations Write equations and inequalities that require planning, manipulating, and/or solving
	Board Objective: I can complete the square to transform a quadratic equation written in standard form.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of “routine” homework with 1 to 2 high level questions	Note: Students should learn of the existence of the complex number system, but will not solve quadratics with complex solutions until Algebra II. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x – p)2 = q that has the same solutions. Derive the quadratic formula from this form. Essential Skills and Knowledge •Ability to solve literal equations for a variable of interest Students should solve by factoring, completing the square, and using the quadratic formula. The zero	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal

• When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	product property is used to explain why the factors are set equal to zero. Students should relate the value of the discriminant to the type of root to expect. A natural extension would be to relate the type of solutions to ax2 + bx + c = 0 to the behavior of the graph of y = ax2 + bx + c . Students should know how to solve equations involving terms with one variable to the second degree. These equations may be written in any form, the most common being the standard form of a quadratic equation, $ax^2 + bx + c = 0$. Students should know and apply the three main ways to solve a quadratic equation: stop, drop, and roll. Oh, wait. Scratch that. We meant factor, complete the square, and the quadratic formula. Your students should already know what factoring is, and that it's possible with simple quadratic equations like $x^2 + x – 12 = 0$. When factoring, students should look for two numbers that add to the coefficient *b* (in this case, 1) and multiply to get the constant *c* (in this case, -12). Easier said than done, unless you've got a mouthful of peanut butter. For the equation $x^2 + x – 12$, the two numbers that work are -3 and 4. They add to get 1 and multiply to get -12, so we can factor $x^2 + x – 12$ into $(x – 3)(x + 4)$. Now it's way easier to solve when we set the equation to equal 0. Since $x – 3 = 0$ and $x + 4 = 0$, our answers are $x = 3$ and x = -4. Note that this method only works when *a* is 1. http://www.shmoop.com/common-core-standards/ccss-hs-a-rei-4.html	learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	approximately, equations in two of more variables, exactly, system of linear equations

ESSENTIAL QUESTIONS:
HOW DO EQUATIONS AND INEQUALITIES HELP MODEL NON-LINEAR RELATIONSHIPS?

GRADE: Algebra II	SUBJECT: Math	STRAND: REI	MONTH(S) TAUGHT:

CODE: **A.REI.4B**	
	Description: A.REI.4b Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b. Unpacked Standard: A.REI.4b Solve quadratic equations in one variable by simple inspection, taking the square root, factoring, and completing the square. A.REI.4b Understand why taking the square root of both sides of an equation yields two solutions. A.REI.4b Use the quadratic formula to solve any quadratic equation, recognizing the formula produces all complex solutions. Write the solutions in the form a ± bi , where a and b are real numbers. A.REI.4b Explain how complex solutions affect the graph of a quadratic equation.
	ACT/Anchor Standard: Numbers: Concepts & Properties: Exhibit some knowledge of the complex numbers Expressions, Equations, & Inequalities: Identify solutions to simple quadratic equations Factor simple quadratics (e.g., the difference of squares and perfect square trinomials) Manipulate expressions and equations Write equations and inequalities that require planning, manipulating, and/or solving
	Board Objective: I can explain how complex solutions affect the graph of a quadratic equation.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer	In Algebra II, in the case of equations having roots with nonzero imaginary parts, students write the solutions as a ± bi where a and b are real numbers. Recognize when the quadratic formula reveals that the quadratic equation has “no real solutions”. Essential Skills and Knowledge •Ability to solve quadratic equations using various methods and recognize the most efficient method •Ability to use the value of the discriminant to determine if a quadratic equation has one double solution, two unique	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good

Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	solutions or no real solutions Students should solve by factoring, completing the square, and using the quadratic formula. The zero product property is used to explain why the factors are set equal to zero. Students should relate the value of the discriminant to the type of root to expect. A natural extension would be to relate the type of solutions to ax2 + bx + c = 0 to the behavior of the graph of y = ax2 + bx + c . Students should know how to solve equations involving terms with one variable to the second degree. These equations may be written in any form, the most common being the standard form of a quadratic equation, $ax^2 + bx + c = 0$. Students should know and apply the three main ways to solve a quadratic equation: stop, drop, and roll. Oh, wait. Scratch that. We meant factor, complete the square, and the quadratic formula. Your students should already know what factoring is, and that it's possible with simple quadratic equations like $x^2 + x - 12 = 0$. When factoring, students should look for two numbers that add to the coefficient *b* (in this case, 1) and multiply to get the constant *c* (in this case, -12). Easier said than done, unless you've got a mouthful of peanut butter. For the equation $x^2 + x - 12$, the two numbers that work are -3 and 4. They add to get 1 and multiply to get -12, so we can factor $x^2 + x - 12$ into $(x - 3)(x + 4)$. Now it's way easier to solve when we set the equation to equal 0. Since $x - 3 = 0$ and $x + 4 = 0$, our answers are $x = 3$ and x = -4. Note that this method only works when *a* is 1. http://www.shmoop.com/common-core-standards/ccss-hs-a-rei-4.html	mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:

http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	

ESSENTIAL QUESTIONS:
WHAT ARE RATIONAL EXPRESSIONS? WHAT IS A RATIONAL NUMBER AND AN IRRATIONAL NUMBER? WHAT IS A RADICAL AND HOW CAN IT BE USED TO SOLVE QUADRATIC EQUATIONS? WHAT ARE INVERSE VARIATIONS? WHAT ARE RATIONAL FUNCTIONS AND RATIONAL EQUATIONS?

GRADE: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **A.REI.6**	Description: A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. A.REI.6 Solve systems of equations using graphs.
	ACT/Anchor Standard: Expressions, Equations, & Inequalities: Find solutions to systems of linear equations
	Board Objective: I can solve systems of equations using graphs or algebra.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
Students need to be able to: • Solve a system of linear equations using substitution • Solve a system of linear equations using elimination • Solve a system of linear equations using graphs	**In Algebra II, tasks are limited to 3x3 systems.** **Clarifying Objectives**: Solve systems of equations exactly by using the substitution method and solve systems of equations by using the elimination method (sometimes called linear combinations). Solve systems of equations approximately by using graphs. Graph the system of linear functions on the same coordinate plane and find the point of intersection. This point is the solution to the system because it is the one point that makes all equations in the system true. Equations may be in standard or slope-intercept form. The system solution methods can include but are not limited to graphical, elimination/linear combination, substitution, and modeling. Systems can be written algebraically or can be represented in context. Students may use graphing calculators, programs, or applets to model and find approximate solutions for systems of equations. By now, students should know that a linear equation given by $y = mx + b$ (or a variation of it) and makes a line on a graph. They should also know that a system of linear equations means that we have more than one $y = mx + b$ equation in the mix. So far, so good. Solving a system of linear equations means finding the point at which the two (or more?) lines intersect. This happens when the same set of	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems.

	x and *y* values satisfy all the linear equations in the system. What about lines that never intersect? Well, they're parallel, for starters. But that just means that the system of parallel lines will have no solution. (It may be helpful to tell your students that "No solution" is a legitimate answer, but only after they've done the work to prove it. Otherwise you'll get "No solution" as the answer to every homework problem.) Students should be shown that a system of linear equations can be solved either through graphs or straight algebra, but that these two methods arrive at the same answer because they mean the same thing. The goal is to find the point at which the two lines intersect. http://www.shmoop.com/common-core-standards/ccss-hs-a-rei-6.html	Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/		• System of linear equations • Solution of a system • Substitution method • Elimination method • Intersection

Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	

ESSENTIAL QUESTIONS:
HOW CAN BOTH ALGEBRA AND GRAPHS BE USED TO SOLVE EQUATIONS?

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **A.REI.11**	Description: A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, 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, polynomial, rational, absolute value, exponential, and logarithmic functions. A.REI.11 Explain why the intersection of y = f(x) and y = g(x) is the solution of f(x) = g(x) for any combination of linear, polynomial, rational, absolute value, exponential, and logarithmic functions. Find the solution(s) by: Using technology to graph the equations and determine their point of intersection, Using tables of values, or Using successive approximations that become closer and closer to the actual value.
	ACT/Anchor Standard: Graphical Representations: Interpret and use information from graphs in the coordinate plane
	Board Objective: I can use and equation and graph to represent the same thing.

ASSESSMENTS:	CONCEPT NOTES	STRATEGIES:
Students need to be able to: • Explain that a point of intersection on the graph of a system of equations, *y = f(x)* and *y = g(x)*, represents a solution to both equations • Infer that since *y = f(x)* and *y = g(x)*, *f(x) = g(x)* by the substitution property • Infer that the x-coordinate of the points of intersection for *y = f(x)* and *y = g(x)* are also solutions for *f(x) = g(x)* • Use a graphing calculator to determine the approximate solutions to a system of	**Clarifying Objectives**: Understand that solving a one-variable equation of the form f(x) = g(x) is the same as solving the two variable system y = f(x) and y = g(x). When solving by graphing, the x-value(s) of the intersection point(s) of y = f(x) and y = g(x) is the solution of f(x) = g(x) for any combination of linear and exponential functions. Use technology, entering f(x) in y1 and g(x) in y2, graphing the equations to find their point of equality. *At this level, focus on linear and exponential functions.* Solve graphically, finding approximate solutions using technology. *At this level, focus on linear and exponential functions.* Solve by making tables for each side of the equation. Use the results from substituting previous values of x to decide whether to try a larger or smaller value of x to find where the two sides are equal. The x-value that makes the two sides equal is the solution to the equation. *At this level, focus on linear and exponential functions.* Students need to understand that numerical solution methods (data in a table used to approximate an algebraic function) and graphical	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course.

equations In Algebra II, tasks may involve any of the function types mentioned in the standard.	solution methods may produce approximate solutions, and algebraic solution methods produce precise solutions that can be represented graphically or numerically. Students may use graphing calculators or programs to generate tables of values, graph, or solve a variety of functions. Students should understand that an equation and its graph are just two different representations of the same thing. The graph of the line or curve of a two-variable equation shows in visual form all of the solutions (infinite as they may be) to our equation in written form. When two equations are set to equal one another, their solution is the point at which graphically they intersect one another. Depending on the equations (and the alignment of the planets), there might be one solution, or more, or none at all. Students can arrive at the correct answer(s) through graphing the functions and plotting their intersection points, creating a table of x and $f(x)$ values, and solving for x algebraically when $f(x) = g(x)$. These strategies should be provided to students and practiced with students so that the connection between graphs and equations are solidified.	**CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:
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Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	

ESSENTIAL QUESTIONS:
WHAT ARE POLYNOMIALS AND HOW DO YOU FACTOR THEM? WHAT IS A GREATEST COMMON FACTOR AND HOW DO YOU FIND IT? HOW DO YOU WORK WITH VARIABLES WHEN THEY HAVE EXPONENTS?

GRADE: Algebra II	SUBJECT: Math	STRAND: N.Q	MONTH(S) TAUGHT:

CODE: **N.Q.2**	Description: N.Q.2 Define appropriate quantities for the purpose of descriptive modeling. Unpacked Standard: N.Q.2 Determine and interpret appropriate quantities when using descriptive modeling.
	ACT/Anchor Standard: Basic Operations & Applications: Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour) Expressions, Equations, & Inequalities: Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions) Write expressions, equations, and inequalities for common algebra settings
	Board Objective: I can select and use units of measure to accurately model a real-world scenario.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES:
This standard will be assessed in Algebra II by ensuring that some modeling tasks (involving Algebra II content or securely held content from previous grades and courses) require the student to create a quantity of interest in the situation being described (i.e., this is not provided in the task). For example, in a situation involving periodic phenomena, the student	**Clarifying Objectives**: Reason quantitatively and use units to solve problems. You've assigned your math class a set of word problems. One of the questions ends with, "How many people voted for candidate Jones?" Fingers fly over calculators as your students try to determine the correct answer. After a minute or two, Tommy raises his hand and announces his answer: 4,602.28 Everything inside of you wants to scream, "Are you out of your mind, Tommy boy? A closer answer would be 4 because at least it would be possible! How on earth could a candidate receive 28 hundredths of a	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all

might autonomously decide that amplitude is a key variable in a situation, and then choose to work with peak amplitude. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW)	vote?" Okay, breathe. Poor Tommy has made the kind of error that drives math teachers like you to the brink of insanity. He's given an answer that makes absolutely no sense. Whatever else math is or isn't, it is always logical. Answers should always make sense. Math frequently relies on general knowledge—concepts that we assume are known by everyone over the age of about seven—along with a healthy dose of common sense (not you, Thomas Paine). The problem, of course, is that people have a tendency to ignore both common sense and the knowledge that they possess. Particularly when calculators are involved, there's the tendency to run with the answer you're given. That ignores one very basic principle: the calculator answers the question you ask, not the one you intended to ask. Every answer, every step along the way, should always be reality-based. Make sure your students know that.	three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

• Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions		
RESOURCES:		VOCABULARY:
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Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
WHY IS REASONING QUANTITATIVELY USEFUL?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **F.IF.3**	
	Description: F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$. Unpacked Standard F.IF.3 Recognize that sequences, sometimes defined recursively, are functions whose domain is a subset of the set of integers.
	ACT/Anchor Standard: Numbers: Concepts & Properties: Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor Exhibit knowledge of logarithms and geometric sequences Expressions, Equations, & Inequalities: Write expressions, equations, and inequalities for common algebra settings Functions: Evaluate polynomial functions, expressed in function notation, at integer values
	Board Objective: Analyze functions using different representations to become better problem solvers.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks	Note: Draw connection to F.BF.2, which requires students to write arithmetic and geometric sequences. Emphasize arithmetic and geometric sequences as examples of linear and exponential functions. When handling functions (careful, they're fragile!), it's easy to see patterns emerge when comparing the *x* and *y* values to each other. Students should know that these patterns are *not* coincidences and, unlike certain patterned wallpaper, they won't make your kitchen look	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches

students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	like it belongs in the 1970s. Students should know that these patterns can be thought of as **sequences**, or a list of numbers. Sequences can be either arithmetic (where the same number is added or subtracted) or geometric (where the same number is multiplied or divided). Arithmetic sequences can be converted into functions of the form $A(n) = A(1) + (n - 1)d$ where $A(n)$ is the value of the nth term, $A(1)$ is the value of the first term, n is the term number, and d is the common difference between the terms. So the sequence 3, 8, 13, 18... can be thought of as the function $A(n) = 3 + 5(n - 1)$. That way, the nth term of the sequence will have the value $A(n)$. Geometric series take a similar form: $G(n) = G(1) \times rn^{-1}$ where $G(n)$ is the value of the nth term, $G(1)$ is the value of the first term, n is the term number, and r is the common ratio between the terms. So the sequence 3, 6, 12, 24, 48... can be thought of as the function $G(n) = 3 \times 2n^{-1}$. That way, the nth term of the sequence will have the value $G(n)$. Students should know that sequences can be defined *recursively*, or using previous terms to define future terms. For instance, The Fibonacci sequence is a list of numbers where each term is the sum of the two before it. As such, we end up with 1, 1, 2, 3, 5, 8, 13, and so on. We can define this recursively as $f(n + 1) = f(n) + f(n - 1)$. Once the first two terms are defined, ($f(0) = f(1) = 1$), the	(besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

	sequence can just keep on going, not unlike the Energizer bunny. Students should be so skilled in seeing the functions in sequences that you should find them accidentally converting other things into functions, too. In fact, it should become second nature. We're talking analyzing the number of breaths they take as a function of time. The number of times they sneeze as a function of their allergies. The number of detentions they get as a function of how often they kick soccer balls at Coach Gibson. Sorry, Coach. www.shmoop.com	
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/		DOMAIN RANGE FUNCTION NOTATION INTERVAL PIECEWISE ASYMPTOTE ZEROS SYMMETRY VERTICAL SHIFTS HORIZONTAL SHIFTS STRETCH SHRINK REFLECTION INVERSE RECURSIVE STANDARD DORM

Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	AX + BY = C POINT-SLOPE SLOPE-INTERCEPT X-INTERCEPT Y-INTERCEPT PARALLEL LINES PERPENDICULAR LINES LINEAR PROGRAMMING MODELING SCATTER PLOT CLUSTER
ESSENTIAL QUESTIONS:	
HOW DO YOU ANALYZE FUNCTIONS USING DIFFERENT REPRESENTATIONS? HOW DO LINEAR RELATIONSHIPS HELP MODEL EXPONENTIAL FUNCTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND: F.IF**	**MONTH(S) TAUGHT:**
CODE: **F.IF.4**	Description: Interpret functions that arise in applications in terms of the context. F.IF.4 For a 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; symmetries; end behavior; and periodicity.* Unpacked Standard: F.IF.4 Given a function, identify key features in graphs and tables including: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. F.IF.4 Given the key features of a function, sketch the graph.		

	ACT/Anchor Standard: Graphical Representations: Interpret and use information from graphs in the coordinate plane
	Board Objective: I can use quadratic functions to model and solve problems.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the	Students may be given graphs to interpret or produce graphs given an expression or table for the function, by hand or using technology. Examples: A rocket is launched from 180 feet above the ground at time t = 0. The function that models this situation is given by h = –16t2 + 96t + 180, where t is measured in seconds and h is height above the ground measured in feet. • What is a reasonable domain restriction for t in this context? • Determine the height of the rocket two seconds after it was launched. • Determine the maximum height obtained by the rocket. • Determine the time when the rocket is 100 feet above the ground. • Determine the time at which the rocket hits the ground. • How would you refine your answer to the first question based on your response to the second and fifth questions? Compare the graphs of $y = 3x^2$ and $y = 3x^3$. Let $R(x) = \frac{2}{\sqrt{x-2}}$. Find the domain of $R(x)$. Also find the range, zeros, and asymptotes of $R(x)$. Let $f(x) = 5x^3 - x^2 - 5x + 1$. Graph the function and identify end behavior and any intervals of consta and decrease. It started raining lightly at 5am, then the rainfall became heavier at 7am. By 10am the storm was over, with a total rainfall of 3 inches. It didn't rain for the rest of the day. Sketch a possible graph for the number of inches of rain as a function of time, from midnight to midday.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some

chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Further Explanation: We don't know if you've noticed, but there are a lot of books out there. Some are poetry books, others are murder mysteries, and some are even both. (This haiku is quite the nail-biter: "Mister Green? Hall? Rope? / Keep looking and find the clues / To know who done it.") There are even graphic novels, short stories, and more genres of books out there than we can list. And still, as many as there are, whatever story they contain, they're all books. In the same way, functions are functions regardless of all the different ways we can express them. We can describe a function using words or draw it out on the x-y plane. If we really want, we can find the equation that describes the function or make a table of values to describe it. Students should know that they can use these different methods to describe the same function. They should also know how to do so. Given a verbal description of a function, students should be able to draw the function. It doesn't have to be more than a stick-figure equivalent to the Mona Lisa, but if you ask for the Mona Lisa and you get a Picasso, you'll know there's a problem. Sometimes these verbal descriptions will be straightforward and other times, they should ask students to apply these functions to real-life scenarios (such as a ball being thrown into the air traveling along a parabola). When students can switch back and forth between equations, graphs, and verbal descriptions, they'll be able to appreciate functions from lingual, symbolic, and visible perspectives. After that, all that's left is getting them to appreciate murder mystery haikus, but you can let their English teacher take care of that one. www.shmoop.com	of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:

http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	AXIS OF SYMMETRY, END BEHAVIOR, EXTREME VALUES, INTERCEPTS, INTERVALS, MAXIMUM/MINIMUM VALUES, POLYNOMIALS, QUADRATIC EXPRESSION, QUADRATIC FUNCTIONS, RELATIVE MAXIMUMS AND MINIMUMS, SYMMETRIES, ZEROS
ESSENTIAL QUESTIONS:	
HOW DO QUADRATIC FUNCTIONS HELP MODEL AND SOLVE PROBLEMS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **F.IF.6**	Description: Interpret functions that arise in applications in terms of the context. F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* Unpacked Standard: F.IF.6 Calculate the average rate of change over a specified interval of a function presented symbolically or in a table. F.IF.6 Estimate the average rate of change over a specified interval of a function from the function's graph. F.IF.6 Interpret, in context, the average rate of change of a function over a specified interval.
	ACT/Anchor Standard: Probability, Statistics, & Data Analysis: Manipulate data from tables and graphs Graphical Representations: Exhibit knowledge of slope Determine the slope of a line from points or equations Interpret and use information from graphs in the coordinate plane Functions: Evaluate quadratic functions, expressed in function notation, at integer values Evaluate polynomial functions, expressed in function notation, at integer values
	Board Objective:

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or	Tasks have a real-world context. In Algebra II, tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. Students should know that we can calculate the average rate of change for any function. Having a linear relationship	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches.

<table>
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<td>conceptual knowledge, often requiring two or more steps*
Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer
Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product

Tips for the classroom:
• Assign the right amount of “routine” homework with 1 to 2 high level questions
• When practicing a skill in class, post high level questions on the chalkboard
• Problem of the Week (POW)
• Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc.
• Have students explain how to solve POWs and other high level questions

Before
Quick write
Quiz
KWL</td>
<td>is super nice, but not necessary; as long as we have initial and final values for x and f(x), then they shouldn't have any problems. If they're confused or struggling, we recommend relating rate of change to the slope of a line. Every function has a "slope" between any two points, and the rate of change is how we find that slope.
www.shmoop.com

The table below shows the elapsed time when two different cars pass a 10, 20, 30, 40 and 50 meter mark on a test track.
• For car 1, what is the average velocity (change in distance divided by change in time) between the 0 and 10 meter mark? Between the 0 and 50 meter mark? Between the 20 and 30 meter mark? Analyze the data to describe the motion of car 1.
• How does the velocity of car 1 compare to that of car 2?

<table><tr><td></td><td>Car 1</td><td>Car 2</td></tr><tr><td>d</td><td>t</td><td>t</td></tr><tr><td>10</td><td>4.472</td><td>1.742</td></tr><tr><td>20</td><td>6.325</td><td>2.899</td></tr><tr><td>30</td><td>7.746</td><td>3.831</td></tr><tr><td>40</td><td>8.944</td><td>4.633</td></tr><tr><td>50</td><td>10</td><td>5.348</td></tr></table>
Key characteristics include but are not limited to maxima, minima, intercepts, symmetry, end behavior, and asymptotes. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to graph functions.</td>
<td>Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach.

Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course.

CPA Approach:
Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems.

Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples.

Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.</td>
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During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf		
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html		AXIS OF SYMMETRY, END BEHAVIOR, EXTREME VALUES, INTERCEPTS, INTERVALS, MAXIMUM/MINIMUM VALUES, POLYNOMIALS, QUADRATIC EXPRESSION, QUADRATIC FUNCTIONS, RELATIVE MAXIMUMS AND MINIMUMS, SYMMETRIES, ZEROS

Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO QUADRATIC FUNCTIONS HELP MODEL AND SOLVE PROBLEMS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **F.IF.7**	Description: Analyze functions using different representations. F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.* c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.* d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.* e. **Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*** Unpacked Standard: F.IF.7 Graph functions expressed symbolically and show key features of the graph. Graph simple cases by hand, and use technology to show more complicated cases including: F.IF.7a Linear functions showing intercepts, quadratic functions showing intercepts, maxima, or minima. F.IF.7b Square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. **Algebra II: F.IF.7c Polynomial functions, identifying zeros when factorable, and showing end behavior.**		

	Algebra II: F.IF.7d (+) Rational functions, identifying zeros and asymptotes when factorable, and showing end behavior. **Algebra II: F.IF.7e Exponential and logarithmic functions, showing intercepts and end behavior.** **Algebra II: F.IF.7e Trigonometric functions, showing period, midline, and amplitude.**
	ACT/Anchor Standard: Numbers: Concepts & Properties: Exhibit knowledge of logarithms and geometric sequences Graphical Representations: Locate points in the coordinate plane Match linear graphs with their equations Interpret and use information from graphs in the coordinate plane Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle) Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$ Functions: Match graphs of basic trigonometric functions with their equations
	Board Objective: I can graph functions and show key features of the graph.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer	7A Students should know the slope-intercept form of linear functions, y = mx + b, and how to extract enough information from the equation to be able to draw it. Since two points define a line, two points are all we need. The y-intercept is practically given to us. It's b from the equation. So the y-intercept of the line y = 2x – 3 is -3. Then, any other point will do. Just plug in any old x, and a y will pop out. There's our second point. Connect 'em, and we're golden. Once students can handle lines, they should move on to the next phase: quadratics. They should already know how to find the x-intercepts of a parabola via factoring, completing the square, or the handy dandy quadratic formula. Then, plugging in 0 for x should give them the y-intercept, and that	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the

Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test	information should be enough to get a rough idea of the shape of the parabola. 7B Students might not understand how one function can have two different equations. Explain to them that it can be done so long as the two functions exist for different values of x. 7C *Starting in Algebra II Well, your students will undoubtedly get bored with quadratics but instead of throwing in their parabolic towels, they'll spice mathematics up with **polynomials**. Students should know what polynomials are. Polynomials are just one degree higher than a quadratic. Actually, they can be as many degrees higher as they want, as long as the degrees are *positive whole numbers*. So the equation $y = x^5 + x^4 - 4x - 4$ is a polynomial, but $y = x^{8/}{}_3 + 3x + 7$ is not. As far as end behavior goes, students should know to look at the highest degree of the polynomial and its coefficient, *axn*. If *n* is *even*, the function will extend either up or down on both ends (as *x* goes to positive or negative infinity). If *n* is *odd*, they'll go in opposite directions. If *a* is *positive*, the even powered functions will go up and the odd powered functions will start down and go up. If *a* is *negative*, the even powered functions will go down, and the odd powered functions will start up and go down. The highest order also gives us the maximum number of roots (*x*-intercepts) the function can have. A function whose highest order is 8 could have, at most, 8 *x*-intercepts, but it could have 7 or 6 or even 0. Just as before, we can find the zeros by factoring the equation into linear factors and then setting each individual factor to equal 0.	justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by

Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	7D Rational functions are like polynomials with more freedom. We can have denominators, but that also means we have asymptotes, or boundaries that the function gets closer and closer to, but never actually reaches. Vertical asymptotes exist when the denominator of the function is 0. 7E Graphing exponential functions allows us to describe the growth of a microorganism or the exponential decay of a radioactive material. Or the decibel level of an audience's applause after performing an underwater escape from a tank full of sharks, handcuffed and blindfolded. In Algebra II, tasks may involve polynomial, exponential, logarithmic, and trigonometric functions.	using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/		AXIS OF SYMMETRY, END BEHAVIOR, EXTREME VALUES, INTERCEPTS, INTERVALS, MAXIMUM/MINIMUM VALUES, POLYNOMIALS, QUADRATIC EXPRESSION, QUADRATIC FUNCTIONS, RELATIVE MAXIMUMS AND MINIMUMS, SYMMETRIES, ZEROS

Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO QUADRATIC FUNCTIONS HELP MODEL AND SOLVE PROBLEMS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **F.IF.8**	Description: Analyze functions using different representations. F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. **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 = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth and decay.**		
	ACT/Anchor Standard: Numbers: Concepts & Properties: Apply rules of exponents Expressions, Equations, & Inequalities: Factor simple quadratics (e.g., the difference of squares and perfect square trinomials) Manipulate expressions and equations Graphical Representations:		

	Interpret and use information from graphs in the coordinate plane	
	Board Objective: I can use functions to solve problems.	
ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet,	8a Students should be able to find the *x*-intercepts of a quadratic function using both **factoring** and **completing the square**. All that should be given to students is the standard form of a quadratic equation in the form $y = ax^2 + bx + c$. When $a = 1$, factoring is fairly easy. The equation can be factored into the form $y = (x + p)(x + q)$, where $p + q = b$ and $pq = c$. For example, if given the equation $y = x^2 – 9x + 18$, we'd need p and q values such that $p + q = -9$ and $pq = 18$. A quick check will tell us that $p = -3$ and $q = -6$ are the values that make sense. So our factored equation is $y = (x – 3)(x – 6)$. Since $y = 0$ for *x*-intercepts, we can set the factored form of our equation to equal zero. The entire equation will be zero when either (or both) of the factors are zero. We can find the roots by solving each factor for *x*. The factors $x – 3 = 0$ and $x – 6 = 0$ mean that our *x*-intercepts are 3 and 6. Completing the square is another way to factor. So much information can be extracted from the different forms of writing a quadratic equation. If students are lost and confused within the many terms of a quadratic equation, the standard form is their landmark. From there, they can	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of

etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	get wherever they need to go and find whatever they need to find. 8b If we have a function of the form $y = abx$, we can either be describing exponential growth or exponential decay. If $a > 0$ and $0 < b < 1$, the equation represents **decay**. If $a > 0$ and $b > 1$, the equation represents **growth**. Equations like $y = a(1 + c)x$ can represent the balance of a savings account after x years with starting balance a and interest rate c. If the annual interest rate is 2% and we start with \$100, how much money will we have in 10 years? Just substitute in our values, and we're good to go. $y = a(1 + c)x = 100(1 + 0.02)^{10} = \$121.90$	the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath		AXIS OF SYMMETRY, END BEHAVIOR, EXTREME VALUES, INTERCEPTS, INTERVALS, MAXIMUM/MINIMUM VALUES, POLYNOMIALS, QUADRATIC EXPRESSION, QUADRATIC FUNCTIONS, RELATIVE MAXIMUMS AND MINIMUMS, SYMMETRIES, ZEROS

9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO QUADRATIC FUNCTIONS HELP MODEL AND SOLVE PROBLEMS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **F.IF.9**	Description: Analyze functions using different representations. F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. Unpacked Standard: F.IF.9 Compare the key features of two functions represented in different ways. For example, compare the end behavior of two functions, one of which is represented graphically and the other is represented symbolically.		

	ACT/Anchor Standard: Probability, Statistics, & Data Analysis: Interpret and use information from figures, tables, and graphs Expressions, Equations, & Inequalities: Evaluate algebraic expressions by substituting integers for unknown quantities Manipulate expressions and equations Graphical Representations: Interpret and use information from graphs in the coordinate plane
	Board Objective: I can compare functions in different ways to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product	In Algebra II, tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. In a perfect world, we would have explicit equations for all relationships (and we don't just mean the Facebook official ones). We'd just plug in our effort and calculate our reward. But as you may have realized, life is much less predictable and far from perfect. Even still, that doesn't mean we can't make sense out of it. Students should be able to compare two functions even when they're both represented differently. To do this successfully, they have to be able to translate between an equation, a graph, a bunch of words, and a table of values, and understand how certain aspects of one representation impact the rest. Generally, students should start by knowing the difference between polynomial, linear, quadratic, exponential, and	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course.

Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	rational functions, and be able to identify them by equation and by graph. This means that given a parabolic curve, students should automatically look for equations in the form of $y = ax^2 + bx + c$. More specifically, a function $f(x)$ that has a y-intercept of 4 would need to have an equation such that $f(0) = 4$. Similarly, a table of values for this function would be expected to have the point (0, 4). The struggles students might face could be traced back to the different representations of functions. Students may have particular difficulty with one type of representation and as such, may have trouble with conversion. If this becomes a problem, try going over each type of representation side by side, highlighting the corresponding parts of each and matching them like a giant game of connect-the-dots. Students should also know the accuracy of each representation. For instance, a table of values can't conclusively define a certain type of function, while a graph can't pinpoint intercepts with certainty. An equation is the most accurate and useful when defining a function, and students should make use of that. If they can transform any graph, table of values, or description into a mathematical equation that describes the function, they should be good to go. www.shmoop.com	**CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	AVERAGE RATE OF CHANGE, BASE, EQUIVALENT FORMS OF EXPRESSIONS, EXPONENT, EXPONENTIAL FUNCTION, EXPONENTIAL MODEL, LOGARITHM, LOGARITHMIC FUNCTION, STEP FUNCTION, SYSTEM OF EQUATIONS, SYSTEM OF INEQUALITIES, TRANSLATION OF FUNCTION

ESSENTIAL QUESTIONS:
HOW DO FUNCTIONS HELP TO MODEL, ANALYZE AND PREDICT SITUATIONS?

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **F.BF.1**	
	Description: Build a function that models a relationship between two quantities. F.BF.1 Write a function that describes a relationship between two quantities.* a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. c. Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.
	ACT/Anchor Standard: Expressions, Equations, & Inequalities: Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions) Write expressions, equations, and inequalities for common algebra settings Functions: Evaluate composite functions at integer values Write an expression for the composite of two simple functions
	Board Objective: I can describe relationships by using functions.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often	Students will analyze a given problem to determine the function expressed by identifying patterns in the function's rate of change. They will specify intervals of increase, decrease, constancy, and, if possible, relate them to the function's description in words or graphically. Students may use graphing calculators or programs, spreadsheets, or computer	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for

requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write	algebra systems to model functions. Examples: • You buy a $10,000 car with an annual interest rate of 6 percent compounded annually and make monthly payments of $250. Express the amount remaining to be paid off as a function of the number of months, using a recursion equation. • A cup of coffee is initially at a temperature of 93 degrees F. The difference between its temperature and the room temperature of 68º F decreases by 9% each minute. Write a function describing the temperature of the coffee as a function of time. • The radius of a circular oil slick after t hours is given in feet by $r=1-t^2 - 0.5t$, for $0 \le t \le 10$. Find the area of the oil slick as a function of time. A good way to get your students hooked on functions (rather than phonics) is to convince them that functions are all about relationships. For instance, you could say that functions describe their relationships with their parents, their friends, and even celebrities. The glitz and glam of fame should get the attention of at least a few of them. Students should be able to use functions describe relationships between two quantities, usually x and f(x), where f(x) is some output value that depends on the input value x. Within a particular context, students should be able to express a given relationship as a function.	the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf		
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/		ARITHMETIC AND GEOMETRIC SEQUENCES, ARITHMETIC AND GEOMETRIC SITUATIONS, BASE, EFFECT ON GRAPH, END BEHAVIOR, EQUAL DISTANCE OVER EQUAL INTERVALS, EQUAL FACTOR OVER EQUAL INTERVALS, EVEN AND ODD FUNCTIONS, FUNCTIONAL INPUTS, FUNCTION NOTATION, GRAPHS, GRAPHICAL EFFECTS, INTERCEPTS, INTERVALS, PARAMETERS OF LINEAR/EXP, RECURSIVE AND EXPLICIT FORMULAE, RELATIVE MAXIMUM/MINIMUM, SLOPE, SYMMETRY

ESSENTIAL QUESTIONS:
HOW CAN YOU USE FUNCTIONS TO DESCRIBE RELATIONSHIPS? HOW DO FUNCTIONS HELP TO MODEL, ANALYZE AND PREDICT SITUATIONS? HOW DO LINEAR RELATIONSHIPS HELP MODEL EXPONENTIAL FUNCTIONS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **F.BF.3**	
	Description: Build new functions from existing functions. F.BF.3 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. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. Unpacked Standard: F.BF.3 Identify, through experimenting with technology, the effect on the graph of a function by replacing f(x) with f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative). F.BF.3 Given the graphs of the original function and a transformation, determine the value of (k). F.BF.3 Recognize even and odd functions from their graphs and equations.
	ACT/Anchor Standard: Graphical Representations: Interpret and use information from graphs in the coordinate plane Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle) Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$
	Board Objective: I can build a function that models a relationship between two quantities to become a better problem solver. I can build new functions from existing functions to become a better problem solver. I can translate between the geometric description and the equation for a conic section.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge:	Much like replacing sugar with salt can transform a blueberry pie to a	Determine whether a relationship

Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment	foul-tasting disaster, replacing x with x + k or kx can transform a graph. Students should know that adding a constant k to a function will change the graph of the function depending not only on the value of the constant, but on where it is inserted as well. If y = f(x) is changed to y = f(x) + k, the curve will shift vertically (up for k > 0, down if k < 0). Adding k to x such that y = f(x + k) will shift the curve horizontally (left for k > 0, right for k < 0). Multiplying f(x) by a constant k stretches (k > 1) or squishes (0 < k < 1) the graph vertically. If k < 0, the graph is also flipped over the x-axis. Multiplying x by k stretches (k > 0) or squishes (k < 0) the graph horizontally. Students should also know that by definition, a function is even if f(-x) = f(x). If students are confused as to how this happens, give them the function f(x) = x2. It's even because f(-x) = (-x)2 = (-1)2 × (x)2 = 1 × x2 = x2 = f(x). Make sure they know not all functions with even numbers are even functions! It's an unfortunate and too common mistake. Even functions are symmetrical across the y-axis. An odd function is a misnomer because plenty of odd functions aren't strange in the slightest. A function is odd if f(-x) = -f(x). One such function is f(x) = x3, because f(-x) = (-x)3 = (-1)3 × x3 = -1 × x3 = -x3 = -f(x). Convinced? Odd functions are symmetrical about the origin, not across any axis. The best part is that students can have fun squishing and moving and flipping curves to their hearts' content without any nauseating repercussions. That's more than we can say for that pukeberry pie.	(given in contextual, symbolic, tabular, or graphical form) is a function and identify its domain and range. Represent functions in symbols, graphs, tables, diagrams, or words and translate among representations. Recognize that functions may be defined by different expressions over different intervals of their domains; such functions are piecewise-defined. Use the unit circle to define sine and cosine; approximate values of sine and cosine; use sine and cosine to define the remaining trigonometric functions; explain why the trigonometric functions are periodic. Use the relationship between degree and radian measures to solve problems. Use the unit circle to define sine and cosine; approximate values of sine and cosine; use sine and cosine to define the remaining trigonometric functions; explain why the trigonometric functions are periodic.

Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf		Explain the exponential relationship between a number and its base 10 logarithm and use it to relate rules of logarithms to those of exponents in expressions involving numbers.
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/		ARITHMETIC AND GEOMETRIC SEQUENCES, ARITHMETIC AND GEOMETRIC SITUATIONS, BASE, EFFECT ON GRAPH, END BEHAVIOR, EQUAL DISTANCE OVER EQUAL INTERVALS, EQUAL FACTOR OVER EQUAL INTERVALS, EVEN AND ODD FUNCTIONS, FUNCTIONAL INPUTS, FUNCTION NOTATION, GRAPHS, GRAPHICAL EFFECTS, INTERCEPTS, INTERVALS, PARAMETERS OF LINEAR/EXP, RECURSIVE AND EXPLICIT FORMULAE, RELATIVE MAXIMUM/MINIMUM, SLOPE, SYMMETRY

http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW SO YOU BUILD A FUNCTION THAT MODELS A RELATIONSHIP BETWEEN TWO QUANTITIES? HOW DO LINEAR RELATIONSHIPS HELP MODEL EXPONENTIAL FUNCTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.ID.6**	Description: S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. **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 and exponential models.** b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association. Unpacked Standard: ▪ **S.ID.6 Create a scatter plot from two quantitative variables. S.ID.6 Describe the form, strength and direction of the relationship.** ▪ **S.ID.6a Categorize data as linear or not. Use algebraic methods and technology to fit a linear function to the data. Use the**		

	function to predict values. ▪ **S.ID.6a Explain the meaning of the slope and y-intercept in context.** ▪ **S.ID.6a Categorize data as exponential. Use algebraic methods and technology to fit an exponential function to the data. Use the function to predict values.** ▪ **S.ID.6a Explain the meaning of the growth rate and y-intercept in context.** ▪ **S.ID.6a Categorize data as quadratic. Use algebraic methods and technology to fit a quadratic function to the data. Use the function to predict values.** ▪ **S.ID.6a Explain the meaning of the constant and coefficients in context.** ▪ S.ID.6b Calculate a residual. Create and analyze a residual plot. ▪ S.ID.6c Categorize data as linear or not. Use algebraic methods and technology to fit a linear function to the data. Use the function to predict values.
	ACT/Anchor Standard: Probability, Statistics, & Data Analysis: Translate from one representation of data to another (e.g., a bar graph to a circle graph) Manipulate data from tables and graphs Interpret and use information from figures, tables, and graphs Graphical Representations: Locate points in the coordinate plane Determine the slope of a line from points or equations Match linear graphs with their equations Interpret and use information from graphs in the coordinate plane
	Board Objective: I can manipulate data from tables and graphs and interpret data from figures, tables and graphs.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks	Note: S.ID.6.a.b. & c, Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. a. Essential Skills and Knowledge ▪ Ability to recognize types of relationships that lend themselves to linear and exponential models	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize

students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After	▪ Ability to create and use regression models to represent a contextual situation b. Informally assess the fit of a function by plotting and analyzing residuals. Note: Focus on linear models, but may use this standard to preview quadratic functions in Unit 5 of this course Essential Skills and Knowledge ▪ Ability to create a graphic display of residuals ▪ Ability to recognize patterns in residual plots • Ability to calculate error margins (residuals) with a calculator c. Fit a linear function for a scatter plot that suggests a linear association (SC –Algebra I) Essential Skills and Knowledge ▪ Ability to recognize a linear relationship displayed in a scatter plot ▪ Ability to determine an equation for the line of best fit for a set of data points Even if they don't seem like it sometimes, people are complex and endlessly interesting. Every person is the combination of so many different traits—hair color, eye color, weight, height, nationality, sex, gender, age—that it's practically impossible for any two to be identical. Students should already know that these different traits are called variables because... well, they vary. Some variables have nothing to do with one another (your age doesn't	these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	affect your eye color, does it?), but others, like height and weight, are related in some way. An excellent way to plot out the relationship between two variables is to use a scatter plot.	
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/		CONTEXT OF DATA, DIFFERENCES (CENTER, SHAPE, SPREAD), EXPONENTIAL, INTERQUARTILE RANGE, MEASURES OF CENTER, MEASURES OF SPREAD, MEAN, MEDIAN, MODELS OUTLIERS, SLOPE, STANDARD DEVIATION

ESSENTIAL QUESTIONS:
HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **F.LE.2**	Description: F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). Unpacked Standard **F.LE.2** Create linear and exponential functions given the following situations: ▪ arithmetic and geometric sequences ▪ a graph ▪ a description of a relationship ▪ two points, which can be read from a table
	ACT/Anchor Standard: **Algebra I** Write linear equations in standard form and slope-intercept form when given two points, a point and the slope, or the graph of the

	equation Identify arithmetic sequences and patterns in a set of data **Algebra II** Convert exponential equations to logarithmic form and logarithmic equations to exponential form Find the *n*th term of an arithmetic or geometric sequence Find the position of a given term of an arithmetic or geometric sequence
	Board Objective: I can write linear equations in standard form. I can create exponential functions.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions	Note: In constructing linear functions draw on and consolidate previous work on finding equations for lines and linear functions (8.EE.6, 8.F). In Algebra II, tasks will include solving multi-step problems by constructing linear and exponential functions. Essential Skills and Knowledge ▪ Ability to produce an algebraic model Students should know that any relationship is all about give and take. For instance, you'll give them an A if they take their homework seriously. In any case, you've been giving them functions for far too long now. It's their turn to give some functions back. Students should know the difference between an arithmetic sequence and a geometric sequence. An arithmetic sequence is a list of numbers in which we add a constant number to the previous one. A geometric sequence is a list of numbers in which we multiply the previous number by a constant called the "common ratio." Basically, arithmetic is addition and geometric is multiplication.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems.

Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Given a graph of an equation or inequality, pairs of input and output values, and a description of a relationship, students should be able to come up with an algebraic way to represent it. Namely, functions. It's easiest to start with input and output values. That way, the students can clearly see how x is changing relative to f(x). For more go to http://www.shmoop.com/common-core-standards/ccss-hs-f-le-2.html	Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf		ARITHMETIC AND GEOMETRIC SEQUENCES, ARITHMETIC AND GEOMETRIC SITUATIONS, BASE, EFFECT ON GRAPH, END BEHAVIOR, EQUAL DISTANCE OVER EQUAL INTERVALS, EQUAL FACTOR OVER EQUAL INTERVALS, EVEN AND ODD FUNCTIONS, FUNCTIONAL INPUTS, FUNCTION NOTATION, GRAPHS, GRAPHICAL EFFECTS, INTERCEPTS, INTERVALS, PARAMETERS OF LINEAR/EXP, RECURSIVE AND EXPLICIT FORMULAE, RELATIVE MAXIMUM/MINIMUM, SLOPE, SYMMETRY

www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
WHAT WAYS OF THINKING CAN BE USED TO SOLVE NEW PROBLEMS? HOW DO LINEAR RELATIONSHIPS HELP MODEL EXPONENTIAL FUNCTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **F.LE.5**	Description: F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context. Unpacked Standard F.LE.5 Based on the context of a situation, explain the meaning of the coefficients, factors, exponents, and/or intercepts in a linear or exponential function.		
	ACT/Anchor Standard: Algebra I: Write and graph linear equations and inequalities from real-world situations (e.g., a constant-rate distance/time problem) Recognize the concept of slope as a rate of change and determine the slope when given the equation of a line in standard form or slope-		

	intercept form, the graph of a line, two points, or a verbal description Graph a linear equation using a table of values, x- and y-intercepts, slope-intercept form, and technology Translate between different representations of relations and functions: graphs, equations, sets of ordered pairs, verbal descriptions, and tables Precalculus: Solve exponential and logarithmic equations and real-world problems involving exponential and logarithmic equations (e.g., compound interest, exponential growth and decay)
	Board Objective: I can explain the meaning of the coefficients, factors, exponents, and/or intercepts in a linear or exponential function.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions	**Tasks have a real-world context. In Algebra II, tasks include exponential functions with domains not in the integers.** Essential Skills and Knowledge • Ability to interpret the slope and y-intercept of a linear model in terms of context • Ability to identify the initial amount present in an exponential model Your students have been solving linear and exponential functions for what feels like centuries, and it's about to come to an end. As one final test of everything they've learned, you ask them a simple question. "Okay, class. We have y dollars in revenue for every x packets of gum sold and y = 0.95x. If x equals 20, how much will y equal?" Jimmy, a brilliant young student of yours, beams up at you and answers, "It'll equal 19 packets of gum." Your heart sinks to the floor, and you realize your mistake all along. It's not enough to understand how to solve linear and exponential functions. Sure, it's useful, but it just won't cut it. Students should know what equations actually mean when applied to certain contexts, not	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course.

• When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	just how to solve for x. Understanding an equation's context is important not only so that students know in what units to report their answers (in dollars and not packets of gum), but also in order to take in data and make use of it. This means that given a particular context, students should be able to understand trends, make predictions, and extrapolate from the mathematical functions they're given. Some students make these connections quickly and effortlessly, and others might find it a little more difficult to do so. One possible way to assist those struggling students is to assign a clear meaning to each variable so that they know that y always means dollars and x always means packets of gum. In more complex problems such as exponentials and polynomials, it may be useful to break down the problem so that it's clearly understood what is changing by how much for every what. Translating the equation into words or vice versa may help understand the equation in terms of the overall context. (For instance, every additional packet of gum sold, denoted by x, increases the revenue y by 0.95 dollars. That's what the equation y = 0.95x ultimately means.) For more go to http://www.shmoop.com/common-core-standards/ccss-hs-f-le-5.html	**CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:

http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	ARITHMETIC AND GEOMETRIC SEQUENCES, ARITHMETIC AND GEOMETRIC SITUATIONS, BASE, EFFECT ON GRAPH, END BEHAVIOR, EQUAL DISTANCE OVER EQUAL INTERVALS, EQUAL FACTOR OVER EQUAL INTERVALS, EVEN AND ODD FUNCTIONS, FUNCTIONAL INPUTS, FUNCTION NOTATION, GRAPHS, GRAPHICAL EFFECTS, INTERCEPTS, INTERVALS, PARAMETERS OF LINEAR/EXP, RECURSIVE AND EXPLICIT FORMULAE, RELATIVE MAXIMUM/MINIMUM, SLOPE, SYMMETRY
ESSENTIAL QUESTIONS:	
HOW DO LINEAR RELATIONSHIPS HELP MODEL EXPONENTIAL FUNCTIONS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **N.CN.1**	Description: **N.CN.1** 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 real. Unpacked Standard: **N.CN.1** Know that every number is a complex number of the form a + bi, where a and b are real numbers. **N.CN.1** Know that the complex number $i^2 = -1$.
	ACT/Anchor Standard: **Algebra II** Identify complex numbers and write their conjugates Add, subtract, and multiply complex numbers Simplify quotients of complex numbers
	Board Objective: I can perform operations with complex numbers.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES

How Complex Is It? Activity: Perform various operations with imaginary and complex numbers using operations from the real number system Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze,	It's a little-known fact that in Disney World, in the Journey into the Imagination Pavilion, lives a purple dragon named Figment. (No, Figment is not Barney. They're not even related. Figment is a *dragon*, not a dinosaur, and he doesn't have that annoying voice or theme song.) Figment is quite a rule breaker—he does things that others tell him he simply can't. Before the ride was rehabbed, there was a wall toward the end of the ride. It pictured all sorts of things imaginary—pigs that flew and three headed cows and the expression "$i^2 = -1$." What on Earth are we talking about? Well, what the Imagineers at Disney remembered from high school is that there is a field of numbers based on something imaginary. We call this field of numbers "complex numbers" (since "imaginary" sounds a tad too mythical) and its most basic unit is the number *i*. Yes, the number. Not the letter. What's the big deal about *i*? Well, the big deal is that $i = \sqrt{-1}$. Yeah, we know. Square roots and negative numbers just don't go together. Well that was then, and this is now. Once your students get past the idea that -1 can have a square root, they can have lots of fun with imaginary numbers. The complex number system is composed of numbers in the form "$a + bi$," where both a and b are real numbers. (That means we can have numbers like $2 + 5i$ or $7 - 12i$.) Eventually, they can even do all sorts of operations with complex numbers. We'll take it one step at a time, though. Instructional Strategies: N.CN.1-2 Before introducing complex numbers, revisit simpler examples demonstrating how number systems can be seen as “expanding” from other number systems in order to solve more equations. For example, the equation x + 5 = 3 has no solution as a whole numbers, but it has a solution x = -2 as an integers. Similarly, although 7x = 5 has no solution in the integers, it has a	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come

etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write	solution x = 5/7 in the rational numbers. The linear equation ax + b = c, where a, b, and c are rational numbers, always has a solution x in the rational numbers: x = $\frac{(c-b)}{a}$. In order to find solutions of quadratic equations or to create quadratic equations from its solutions, introduce students to the condition of equality of complex numbers, with addition, subtraction and multiplication of complex numbers. Stress the importance of the relationships between different number sets and their properties. The complex number system possesses the same basic properties as the real number system: that addition and multiplication are commutative and associative; the existence of additive identity and multiplicative identity; the existence of an additive inverse for every complex number and the existence of multiplicative inverse or reciprocal for every non- zero complex number; and the distributive property of multiplication over the addition. An awareness of the properties minimizes students' rote memorization and links the rules for manipulations with the complex number system to the rules for manipulations with binomials with real coefficients of the form a + bx. Common Misconceptions: If irrational numbers are confused with non-real or complex numbers, remind students about the relationships between the sets of numbers.	first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf		

RESOURCES:	VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units:	COMPLEX SOLUTIONS, CUBE ROOT, DECREASING BEHAVIOR, END BEHAVIOR, EXTRANEOUS SOLUTIONS, INCREASING BEHAVIOR, INTERVALS, PIECE-WISE FUNCTION, POLYNOMIAL FUNCTION, QUADRATIC EQUATION, RATIONAL EQUATION, REAL COEFFICIENTS, RELATIVE MAXIMUM, RELATIVE MINIMUM, SQUARE ROOT, SUITABLE FACTORIZATION, SYMMETRIES, ZEROS OF POLYNOMIAL

http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO POLYNOMIAL RELATIONSHIPS COMPARE TO NUMERICAL RELATIONSHIPS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **N.CN.2**	Description: N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Unpacked Standard: N.CN.2 Apply the fact that the complex number $i^2 = -1$. N.CN.2 Use the associative, commutative, and distributive properties, to add, subtract, and multiply complex numbers.
	ACT/Anchor Standard: Algebra II Identify complex numbers and write their conjugates Add, subtract, and multiply complex numbers Simplify quotients of complex numbers
	Board Objective: I can perform operations with complex numbers.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom:	**The use of complex numbers is spread throughout mathematics and its applications to science, such as electrical engineering, physics, statistics and aeronautical engineering.** **The existence of complex numbers makes every quadratic equation with real coefficients solvable over the complex number system. This paves the way for the Fundamental Theorem of Algebra, which says that an nth degree polynomial has n solutions in the complex numbers.** Instructional Strategies: N.CN.1-2 Before introducing complex numbers, revisit simpler examples demonstrating how number systems can be seen as "expanding" from other number systems in order to solve more equations. For example, the equation x + 5 = 3 has no solution as a whole numbers, but it has a solution x = -2 as an integers. Similarly, although 7x = 5 has no solution in the integers, it has a solution x = 5/7 in the rational numbers. The linear	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are

• Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	equation ax + b = c, where a, b, and c are rational numbers, always has a solution x in the rational numbers: x = $\frac{(c-b)}{a}$. In order to find solutions of quadratic equations or to create quadratic equations from its solutions, introduce students to the condition of equality of complex numbers, with addition, subtraction and multiplication of complex numbers. Stress the importance of the relationships between different number sets and their properties. The complex number system possesses the same basic properties as the real number system: that addition and multiplication are commutative and associative; the existence of additive identity and multiplicative identity; the existence of an additive inverse for every complex number and the existence of multiplicative inverse or reciprocal for every non- zero complex number; and the distributive property of multiplication over the addition. An awareness of the properties minimizes students' rote memorization and links the rules for manipulations with the complex number system to the rules for manipulations with binomials with real coefficients of the form a + bx. Common Misconceptions: If irrational numbers are confused with non-real or complex numbers, remind students about the relationships between the sets of numbers.	not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	COMPLEX SOLUTIONS, CUBE ROOT, DECREASING BEHAVIOR, END BEHAVIOR, EXTRANEOUS SOLUTIONS, INCREASING BEHAVIOR, INTERVALS, PIECE-WISE FUNCTION, POLYNOMIAL FUNCTION, QUADRATIC EQUATION, RATIONAL EQUATION, REAL COEFFICIENTS, RELATIVE MAXIMUM, RELATIVE MINIMUM, SQUARE ROOT, SUITABLE FACTORIZATION, SYMMETRIES, ZEROS OF POLYNOMIAL
ESSENTIAL QUESTIONS:	

HOW DO POLYNOMIAL RELATIONSHIPS COMPARE TO NUMERICAL RELATIONSHIPS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **N.CN.7**	Description: Solve quadratic equations with real coefficients that have complex solutions. Unpacked Standard: N.CN.7 Solve quadratic equations with real coefficients that have solutions of the form a + bi and a – bi.
	ACT/Anchor Standard: Algebra II Solve quadratic equations with complex number solutions
	Board Objective: I can solve quadratic equations that have complex solutions.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps*	Quadratics with imaginary roots aren't always easy to identify until we get to the point in the problem where we have to take the square root. At that point, if the number under the radical is negative, that parabola's roots will be imaginary. (That number under the radical, $b^2 - 4ac$, is called the **discriminant**. Probably because it discriminates between real and imaginary roots.) Now, your students should be able to calculate the roots of these other parabolas and tell whether or not a parabola will have real or imaginary roots by looking at its discriminant. **Connections**: This standard has a direct connection to the standard **A.REI.4** in the Algebra conceptual category. A solid understanding of number systems, including complex numbers, is foundational for advancing in solving various types of equations, investigating functions and	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the

Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and	sketching their graphs. Revisit quadratic equations with real coefficients and a negative discriminant and point out that this type of equation has no real number solution. Emphasize that with the extension of the real number system to complex numbers any quadratic equation has a solution. Since the process of solving a quadratic equation may involve the use of the quadratic formula with a negative discriminant, defining a square root of a negative number becomes critical $\sqrt{-N} = i\sqrt{N}$, where N is a positive real number; i is the imaginary unit and $i^2 = -1$). After the square root of a negative number has been defined, emphasize that the quadratic formula can be used without restriction. While solving quadratic equations using the quadratic formula, students should observe that the quadratic equation always has a pair of solutions regardless of the value of the discriminant. Common Misconceptions: N.CN.7 In the cases of quadratic equations, when the use of quadratic formula is not critical, students sometime ignore the negative solutions. For example, for the equation $x^2 = 9$, students may mention 3 and forget about (– 3), or mention 3i and forget about (- 3i) for the equation $x^2 = -9$. If this misconception persists, advise students to solve this type of quadratic equation either by factoring or by the quadratic formula	power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the

other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf		pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/	COMPLEX SOLUTIONS, CUBE ROOT, DECREASING BEHAVIOR, END BEHAVIOR, EXTRANEOUS SOLUTIONS, INCREASING BEHAVIOR, INTERVALS, PIECE-WISE FUNCTION, POLYNOMIAL FUNCTION, QUADRATIC EQUATION, RATIONAL EQUATION, REAL COEFFICIENTS, RELATIVE MAXIMUM, RELATIVE MINIMUM, SQUARE ROOT, SUITABLE FACTORIZATION, SYMMETRIES, ZEROS OF POLYNOMIAL

QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO POLYNOMIAL RELATIONSHIPS COMPARE TO NUMERICAL RELATIONSHIPS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE:

A.APR.6

Description: Rewrite simple rational expressions in different forms; write a(x)/b (x) in the form q (x) + 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.

Unpacked Standard:

A.APR.6 Rewrite rational expressions, $\frac{a(x)}{b(x)}$, in the form $q(x)+\frac{r(x)}{b(x)}$ by using factoring, long division, or synthetic division. Use a computer algebra system for complicated examples to assist with building a broader conceptual understanding.

ACT/Anchor Standard:
Algebra II Factor polynomials using a variety of methods (e.g., factor theorem, synthetic division, long division, sums and differences of cubes, grouping)

Board Objective:

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and	Connections: A.SSE Seeing Structure in Expressions. The arithmetic of rational expressions is fundamentally about seeing the same structure in rational expressions as the arithmetic of rational numbers (i.e., fractions). The polynomial q(x) is called the quotient and the polynomial r(x) is called the remainder. Expressing a rational expression in this form allows one to see different properties of the graph, such as horizontal asymptotes. Use a computer algebra system for complicated examples to assist with building a broader conceptual understanding. In order to meet A.APR.6, students will need some experiences with the arithmetic of simple rational expressions. For most students, the above example helps illustrating the similarity of the form of the arithmetic used with rational expressions and the form of the arithmetic used with rational numbers.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all

consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before	Common Misconceptions: A.APR.6 Students with only procedural understanding of fractions are likely to "cancel" terms (rather than factors of) in the numerator and denominator of a fraction. Emphasize the structure of the rational expression: that the whole numerator is divided by the whole denominator. In fact, the word "cancel" likely promotes this misconception. It would be more accurate to talk about dividing the numerator and denominator by a common factor. Simplified (www.shmoop.com) This standard is like a Rube Goldberg machine. It looks far more complicated than it really is. It all boils down to dividing polynomials and expressing the answer properly. Students should have already touched division and fractions at least a little, having been through the third grade and all. In a way, it's just a continuation of the Remainder Theorem, so we recommend covering that first. Students should already know how to divide polynomials by factoring or long division. As with many divisions, they won't all be perfect and a remainder will be left over. Instead of just writing what the remainder is, we now expect students to actually do something with it. Let's say we're dividing a(x) by b(x), and our answer is q(x) with remainder r(x). Just like the Remainder Theorem, if r(x) = 0, then b(x) is a factor of a(x). We know that already. But what if b(x) doesn't divide a(x) with remainder 0? Well, just like simplifying 13⁄4 to 3 with a remainder of 1, or 3¼, we can write a(x)⁄b(x) as q(x) with remainder r(x), or r(x)⁄b(x). Just like a remainder of 1 divided by 4 means ¼, a remainder of r(x) divided by b(x) will give us r(x)⁄b(x). All the talk about the degree of r(x) being less than the degree of b(x) just means that r(x) should be "smaller" than b(x). It wouldn't make sense to split 13⁄4 into 2 5⁄4 because we can still divide 5 by 4. It's the same idea, only polynomial-style. We suggest relating these polynomial quotients to fractions of integers so that students don't	three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols

Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	feel overwhelmed. It's understandable for them to be confused when we throw seven different functions at them, but they'll be a lot more receptive when they're working with concepts they already know. Students should also not be afraid of the big bad long division monster. Often, factoring is near impossible to figure out when remainders are involved and there are times when synthetic division just won't cut it. Students should give in and embrace long division and their lives will be better for it.	is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	

ESSENTIAL QUESTIONS:

HOW DO POLYNOMIAL RELATIONSHIPS COMPARE TO NUMERICAL RELATIONSHIPS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE:	Description: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. Unpacked Standard:		

A.REI.2	Solve simple rational and radical equations in one variable and provide examples of how extraneous solutions arise.
	ACT/Anchor Standard: Algebra II Solve mathematical and real-world rational equation problems (e.g., work or rate problems) Evaluate expressions and solve equations containing nth roots or rational exponents Evaluate and solve radical equations given a formula for a real-world situation
	Board Objective: I can evaluate and solve rational and radical equations.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions	Rational equations might sometimes be a bit more radical than students would like. Those square root signs can instill terror in the heart of any student unprepared for them. If students overcame their fear of monsters under the bed (and hopefully they did), they'll get over their fear of radicals too. Rational equations mean that fractions are involved. Radical equations mean that square roots are involved. Students should know how to deal with both separately and together. A radical equation is one in which the variable is under the radical sign. When solving radical equations, it's usually best to leave the radicals for last unless there's a quick and easy way to get rid of all of them. Students should know how to combine, manipulate, and rewrite radical expressions. This usually takes practice and repetition. When all else fails, tell students to treat radicals like they'd treat variables. This is the one time the Golden Rule doesn't apply. Students should know that sometimes, algebraic manipulation produces extraneous solutions. For example, multiplying the fairly simple equation	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your

• When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	$x + 5 = 0$ by x will give $x^2 + 5x = 0$. Now, both $x = 0$ and $x = -5$ will satisfy that quadratic. However, looking at $x + 5 = 0$, we can see that $x = 0$ won't work for the original equation (because $0 + 5 \neq 0$). That means $x = 0$ is an extraneous solution. To check for extraneous solutions, students should plug in their final answers back into the original equation. If the equation produces an incorrect statement (like $5 = 0$), then they'll know that solution didn't really exist.	topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
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ESSENTIAL QUESTIONS:
HOW DO POLYNOMIAL RELATIONSHIPS COMPARE TO NUMERICAL RELATIONSHIPS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **A.REI.7**	Description: 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 $x^2 + y^2 = 3$. Unpacked Standard: A.REI.7 Solve a system containing a linear equation and a quadratic equation in two variables (conic sections possible) graphically and symbolically.
	ACT/Anchor Standard: Algebra II Solve quadratic systems graphically and algebraically with and without technology
	Board Objective: I can solve quadratic systems without the use of a computer or calculator.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of	Include systems consisting of one linear and one quadratic equation. Include systems that lead to work with fractions. Students should know that this is a slight expansion on the previous standard. Our only change is that we instead of having two lines, we have a linear equation (a straight line) and a quadratic equation (a not so straight line). No big	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will

more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	deal. In the simplest terms, the quadratic equation is just a linear equation with a square sign over a variable. It can have more terms, but as long as the largest exponent over a variable is 2, it's a quadratic equation. Simple enough, right? Example: Two friends are driving to the Grand Canyon in separate cars. Suzette has been there before and knows the way but Andrea does not. During the trip Andrea gets ahead of Suzette and pulls over to wait for her. Suzette is traveling at a constant rate of 65 miles per hour. Andrea sees Suzette drive past. To catch up, Andrea accelerates at a constant rate. The distance in miles (d) that her car travels as a function of time in hours (t) since Suzette's car passed is given by $d = 3500t^2$. Write and solve a system of equations to determine how long it takes for Andrea to catch up with Suzette Common Misconceptions: A.REI.5-7 Most mistakes that students make are careless rather than conceptual. Teachers should encourage students to learn a certain format for solving systems of equations and check the answers by substituting into all equations in the system. Some students believe that matrices are independent of other areas of mathematics.	most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. **CPA Approach:** Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter

		and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO EQUATIONS AND INEQUALITIES HELP MODEL NON-LINEAR RELATIONSHIPS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **F.TF.1**	Description: Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. Unpacked Standard F.TF.1 Know that if the length of an arc subtended by an angle is the same length as the radius of the circle, then the measure of the angle is 1 radian. F.TF.1 Know that the graph of the function, f, is the graph of the equation y=f(x).
	ACT/Anchor Standard: Algebra II Use the unit-circle definition of the trigonometric functions and trigonometric relationships to find trigonometric values for general angles Measure angles in standard position using degree or radian measure and convert a measure from one unit to the other
	Board Objective: I understand how to use radians and why they are useful.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Trig Exit Check: Evaluate and analyze a real world	Connections: F.TF.1-2 The study of trigonometry is reserved for high school students. In	Teach to multiple modalities: Say it; write it, have students write it and do it (as much

situation of a periodic phenomenon through the use of a trigonometric model. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions	the Geometry conceptual category, students explore right triangle trigonometry, with advanced students working with laws of sines and cosines. In the conceptual category of Functions, students connect the idea of functions with trigonometry and see sine, cosine and tangent values as functions of angle values input in radians. Connections are made such as the cosine of an angle equaling the sine of its complement as well as to the Geometry Standards involving radian measures. Know that if the length of an arc subtended by an angle is the same length as the radius of the circle, then the measure of the angle is 1 radian. Know that the graph of the function, f, is the graph of the equation $y = f(x)$. Instructional Strategies: F.TF.1-2 Use a compass and straightedge to explore a unit circle with a fixed radius of 1. Help students to recognize that the circumference of the circle is 2π, which represents the number of radians for one complete revolution around the circle. Students can determine that, for example, $\pi/4$ radians would represent a revolution of 1/8 of the circle or 45°. Having a circle of radius 1, the cosine, for example, is simply the x-value for any ordered pair on the circle (adjacent/hypotenuse where adjacent is the x-length and hypotenuse is 1). Students can examine how a counterclockwise rotation determines a coordinate of a particular point in the unit circle from which sine, cosine, and tangent can be determined. Common Misconceptions: F.TF.1-2	as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize

Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Students may believe that there is no need for radians if one already knows how to use degrees. Students need to be shown a rationale for how radians are unique in terms of finding function values in trigonometry since the radius of the unit circle is 1. Students may also believe that all angles having the same reference values have identical sine, cosine and tangent values. They will need to explore in which quadrants these values are positive and negative. Radians can be intimidating to students. Their whole understanding of angles and circles is being uprooted and replaced with something completely different. Giving lot of simple sketches comparing common angles in degrees with their measures in radians may be helpful.	mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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ESSENTIAL QUESTIONS:	
HOW DO TRIGONOMETRIC FUNCTIONS HELP TO MODEL PERIODIC PHENOMENA?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE:	Description: Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. Unpacked Standard:		

F.TF.2	Explain how radian measures of angles rotated counterclockwise in a unit circle are in a one-to-one correspondence with the nonnegative real numbers, and that angles rotated clockwise in a unit circle are in a one-to- one correspondence with the non-positive real numbers.
	ACT/Anchor Standard: Algebra II Use the unit-circle definition of the trigonometric functions and trigonometric relationships to find trigonometric values for general angles Determine the domain and range of the sine and cosine functions, given a graph
	Board Objective: I understand the uses of radians.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Trig Exit Check: Evaluate and analyze a real world situation of a periodic phenomenon through the use of a trigonometric model. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product	Connections: F.TF.1-2 The study of trigonometry is reserved for high school students. In the Geometry conceptual category, students explore right triangle trigonometry, with advanced students working with laws of sines and cosines. In the conceptual category of Functions, students connect the idea of functions with trigonometry and see sine, cosine and tangent values as functions of angle values input in radians. Connections are made such as the cosine of an angle equaling the sine of its complement as well as to the Geometry Standards involving radian measures. Know that if the length of an arc subtended by an angle is the same length as the radius of the circle, then the measure of the angle is 1 radian. Know that the graph of the function, f, is the graph of the equation $y = f(x)$. Instructional Strategies: F.TF.1-2 Use a compass and straightedge to explore a unit circle with a fixed radius of 1. Help students to recognize that the circumference of the circle is 2π, which represents the number of radians for one	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students

Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	complete revolution around the circle. Students can determine that, for example, π/4 radians would represent a revolution of 1/8 of the circle or 45°. Having a circle of radius 1, the cosine, for example, is simply the x-value for any ordered pair on the circle (adjacent/hypotenuse where adjacent is the x-length and hypotenuse is 1). Students can examine how a counterclockwise rotation determines a coordinate of a particular point in the unit circle from which sine, cosine, and tangent can be determined. Common Misconceptions: F.TF.1-2 Students may believe that there is no need for radians if one already knows how to use degrees. Students need to be shown a rationale for how radians are unique in terms of finding function values in trigonometry since the radius of the unit circle is 1. Students may also believe that all angles having the same reference values have identical sine, cosine and tangent values. They will need to explore in which quadrants these values are positive and negative. Radians can be intimidating to students. Their whole understanding of angles and circles is being uprooted and replaced with something completely different. Giving lot of simple sketches comparing common angles in degrees with their measures in radians may be helpful.	will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:	VOCABULARY:	

AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	AMPLITUDE, COSINE, EXTENSION OF TRIGONOMETRIC FUNCTIONS, MIDLINE, PERIODIC, PHENOMENA, PERIODICITY, RADIAN MEASURE, SINE, TANGENT, TRIGONOMETRIC FUNCTIONS, UNIT CIRCLE

ESSENTIAL QUESTIONS:
HOW DO TRIGONOMETRIC FUNCTIONS HELP TO MODEL PERIODIC PHENOMENA?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **G.GPE.2**	Description: Derive the equation of a parabola given a focus and directrix. Unpacked Standard: G.GPE.2 Given a focus and directrix, derive the equation of a parabola. G.GPE.2 Given a parabola, identify the vertex, focus, directrix, and axis of symmetry, noting that every point on the parabola is the same distance from the focus and the directrix.
	ACT/Anchor Standard: Algebra II Determine characteristics of circles and parabolas from their equations and graphs Identify and write equations for circles and parabolas from given characteristics and graphs
	Board Objective: I can use algebraic reasoning to interpret geometric relationships.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or	What do your satellite dish, the path that Katniss Everdeen's arrow would follow if she aimed up in the sky, and the water swirling around inside a flushing toilet all have in common? Parabolas. Yes, you heard us right. The shape you get from slicing a cone perpendicularly to its base shows up in plenty of unusual real-world places.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical

conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL	Students should already know that parabolas, like pretty much everything else in the Mathland, can be labeled with their own unique equations in the form y = ax2 + bx + c. But giving your students the values of a, b, and c would just be too easy, don't you think? Instead, have them find the equation when given a focus and directrix. Students should know that a focus is a point near a parabola and a directrix is a line near a parabola. So what's so special about them? In Mathese, the parabola is the set of all the points that are the same distance between two things: a given point and a given line. Sideways parabolas may exist in the real world when the satellite dish gets knocked over or when you stand on a platform and throw a boomerang. Hopefully, the watery flushing toilet parabola never goes sideways. The directrix should be parallel to a coordinate axis. Find the distance from a point on the parabola (x, y) to the directrix. Find the distance from a point on the parabola (x, y) to the focus using the distance formula (Pythagorean Theorem). Equate the two distance expressions for a parabola to write its equation. Identify the focus and directrix of a parabola when given its equation. Students may use geometric simulation software to explore parabolas. Examples: ▪ Write and graph an equation for a parabola with focus (2, 3) and directrix y = 1. ▪ Given the equation $20(y-5) = (x+3)^2$, find the focus, vertex and directrix. ▪ Solution: The vertex is at (-3, 5) and to find the vertex we know that the constant of the unsquared term is 20. Since 4p =20 then p = 5. The focus is 5 units above the vertex at (-3, 5+5) or (-3. 10). The directrix is 5 units below the vertex so y = 0. ▪ A parabola has focus (-2. 1) and directrix y = -3. Determine whether or not the point (2, 1) is part of the parabola. Justify your answer.	approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete

During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Define a parabola as a set of points satisfying the condition that their distance from a fixed point (focus) equals their distance from a fixed line (directrix). Start with a horizontal directrix and a focus on the y-axis, and use the distance formula to obtain an equation of the resulting parabola in terms of y and x^2. Next use a vertical directrix and a focus on the x-axis to obtain an equation of a parabola in terms of x and y^2. Make generalizations in which the focus may be any point, but the directrix is still either horizontal or vertical. Allow sufficient time for students to become familiar with new vocabulary and notation. Given y as a quadratic equation of x (or x as a quadratic function of y), complete the square to obtain an equation of a parabola in standard form. Identify the vertex of a parabola when its equation is in standard form and show that the vertex is halfway between the focus and directrix. Investigate practical applications of parabolas and paraboloids.	manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DOES THE COORDINATE SYSTEM HELP TO VERIFY GEOMETRIC RELATIONSHIPS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **F.TF.5**	Description: Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. Unpacked Standard: F.TF.5 Use sine and cosine to model periodic phenomena such as the ocean's tide or the rotation of a Ferris wheel. F.TF.5 Given the amplitude; frequency; and midline in situations or graphs, determine a trigonometric function used to model the situation.		

	ACT/Anchor Standard: Algebra II Find the period and amplitude of the sine and cosine functions, given a graph Use sine, cosine, and tangent functions, including their domains and ranges, periodic nature, and graphs, to interpret and analyze relations Precalculus Graph and write the equations of sine and cosine functions given the amplitude, period, phase shift, and vertical translation; use the functions to model real-life situations (e.g., spring problems, ocean tides)
	Board Objective:

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2	**Explanations and Examples: F.TF.5** Define amplitude, frequency, and midline of a trigonometric function. Explain the connection between frequency and period. Use sine and cosine to model periodic phenomena such as the ocean's tide or the rotation of a Ferris wheel. Given the amplitude; frequency; and midline in situations or graphs, determine a trigonometric function used to model the situation. Write a function notation for the trigonometric function that models a problem situation. **Examples:** The temperature of a chemical reaction oscillates between a low of 20°C and a high of 120°C. The temperature is at its lowest point when t = 0 and completes one cycle over a 6-hour period. a. Sketch the temperature, T, against the elapsed time, t, over a 12-hour period. b. Find the period, amplitude, and the midline of the graph you drew in part a. c. Write a function to represent the relationship between time and temperature. d. What will the temperature of the reaction be 14 hours after it began?	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students

high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	e. At what point during a 24-hour day will the reaction have a temperature of 60°C? Instructional Strategies: F.TF.5 Allow students to explore real-world examples of periodic functions. Examples include average high (or low) temperatures throughout the year, the height of ocean tides as they advance and recede, and the fractional part of the moon that one can see on each day of the month. Graphing some real-world examples can allow students to express the amplitude, frequency, and midline of each. Help students to understand what the value of the sine (cosine, or tangent) means (e.g., that the number represents the ratio of two sides of a right triangle having that angle measure). Using graphing calculators or computer software, as well as graphing simple examples by hand, have students graph a variety of trigonometric functions in which the amplitude, frequency, and/or midline is changed. Students should be able to generalize about parameter changes, such as what happens to the graph of y = cos(x) when the equation is changed to y = 3cos(x) + 5. Common Misconceptions: F.TF.5 Students may believe that all trigonometric functions have a range of 1 to -1. Students need to see examples of how coefficients can change the range and the look of the graphs.	will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
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ESSENTIAL QUESTIONS:	

HOW DO TRIGONOMETRIC FUNCTIONS HELP TO MODEL PERIODIC PHENOMENA?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **N.RN.1**	Description: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5(1^{/3})^3$ to hold, so $(5\ 1^{/3})^3$ must equal 5. Unpacked Standard: N.RN.1 Understand that the denominator of the rational exponent is the root index and the numerator is the exponent of the radicand.
	ACT/Anchor Standard: Algebra II Simplify radicals that have various indices Use properties of roots and rational exponents to evaluate and simplify expressions Add, subtract, multiply, and divide expressions containing radicals Rationalize denominators containing radicals and find the simplest common denominator
	Board Objective: I can extend the properties of exponents to radicals.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often	Connections: N.RN.1-2 Integer exponents (both positive and negative) and radicals were studied in Grade 8. In this cluster, students expand the concept of exponent to include fractional exponents and make a connection to radicals. In more advanced courses, rational exponents will be extended to irrational exponents by means of exponential and logarithmic functions. For example, the definitions for integer and rational exponents will allow for the next step a definition of irrational	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic

requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During	exponents, such as $2^{\sqrt{2}}$ or $2^{1.414213}$..... and then a new class of functions – exponential functions of the form $f(x) = b^x$ where $b \neq 1$, $b > 0$. The domain of this class of functions (the x values) is all real numbers (rational and irrational) and the range is the set of all positive real numbers.) Your students were in fourth or fifth grade when they first learned about exponents. They thought they were mathematical geniuses because they knew that 5 to the second power was 25. And they were pretty sure that was basically all there was to know. Then someone explained that anything to the zero power is one and their heads almost exploded. Well, hopefully they'll hang on to their heads this time, because they're about to learn a whole lot more about exponents. Students should know that when we multiply powers of the same base, the exponents are added together. No surprise there. So $9^{½} \times 9^{½}$ should be the same as $9^{½ + ½}$ which is 9^1 (or just 9). But wait! If we multiply 3 by itself, we also get 9. So $9^{½}$ must equal 3! Are the students confused? Here are a few simple rules for them to follow. 1. You're allowed to have exponents that are fractions. It's really okay. 2. **The denominator of the fraction is the root.** So a denominator of 2 means a square root, a denominator of 3 means a cube root, and a denominator of 10 means the tenth root. (Make sure they know you aren't making this up!) 3. **The numerator of the fraction is the power.** So a number to the two-	(plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples.

Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	thirds power is the cube root of the number squared. 4. It doesn't matter which we do first. If we want to evaluate $8^{\frac{2}{3}}$, we have two choices: square 8 and then take the cube root, or take the cube root of 8 and then square it. We'll get the same answer either way. Most people prefer the second way, since it keeps the numbers smaller. 5. If your students are using a scientific calculator, the combination of the exponent and fraction keys will allow them to raise numbers to fractional exponents. Still, they should really do the exercises without a calculator. That way, if their calculator is at home on the kitchen table, they'll still survive math class.	Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf	ARITHMETIC AND GEOMETRIC SEQUENCES, ARITHMETIC AND GEOMETRIC SITUATIONS, BASE, EFFECT ON GRAPH, END BEHAVIOR, EQUAL DISTANCE OVER EQUAL INTERVALS, EQUAL FACTOR OVER EQUAL INTERVALS, EVEN AND ODD FUNCTIONS, FUNCTIONAL INPUTS, FUNCTION NOTATION, GRAPHS, GRAPHICAL EFFECTS, INTERCEPTS, INTERVALS, PARAMETERS OF LINEAR/EXP, RECURSIVE AND EXPLICIT FORMULAE, RELATIVE MAXIMUM/MINIMUM, SLOPE, SYMMETRY

www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO LINEAR RELATIONSHIPS HELP MODEL NON-LINEAR FUNCTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **N.RN.2**	Description: Rewrite expressions involving radicals and rational exponents using the properties of exponents. Unpacked Standard: N.RN.2 Convert from radical representation to using rational exponents and vise versa.		
	ACT/Anchor Standard: Algebra II Simplify radicals that have various indices Use properties of roots and rational exponents to evaluate and simplify expressions Add, subtract, multiply, and divide expressions containing radicals		

	Rationalize denominators containing radicals and find the simplest common denominator
	Board Objective: I can extend the properties of exponents to radicals.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc.	In the previous standard, we established some rules about fractional exponents. Here's the gist of those rules: 1. We're allowed to have exponents that are fractions. It's really okay. 2. The denominator of the fraction is the root. 3. The numerator of the fraction is the power. 4. It doesn't matter which we do first. Those four little rules mean that it's easy to evaluate a lot of fractional exponents without the use of a calculator. Your students should know that math—real math with scary things like exponents—can be done without a calculator. Yes, using the calculator function on their phone counts as cheating. A pencil and an eraser, on the other hand, does not. Now that we know these rules, we can go from radicals to exponents and vice versa. That'll help us turn some pretty ugly-duckling problems into gorgeous-swan answers. Or at least make the transition from duck to swan significantly less painful than ballet dancer to swan. For example, let's rewrite $\sqrt[3]{64}$ without a radical and evaluate. The 3 outside the radical becomes the denominator. So what do we do for a numerator? The numerator is the power to which 64 is raised. Since no power is listed, we know it's a power of 1. (A number that doesn't have an exponent is to the first power.)	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize

• Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	In exponential form, our answer is $64^{1/3}$. To evaluate it, we just find the number that, when cubed is 64. That'd be 4. Connections: N.RN.1-2 Integer exponents (both positive and negative) and radicals were studied in Grade 8. In this cluster, students expand the concept of exponent to include fractional exponents and make a connection to radicals. In more advanced courses, rational exponents will be extended to irrational exponents by means of exponential and logarithmic functions. For example, the definitions for integer and rational exponents will allow for the next step a definition of irrational exponents, such as $2^{\sqrt{2}}$ or $2^{1.414213}$..... and then a new class of functions – exponential functions of the form $f(x) = b^x$ where $b \neq 1$, $b > 0$. The domain of this class of functions (the x values) is all real numbers (rational and irrational) and the range is the set of all positive real numbers.)	process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com	ARITHMETIC AND GEOMETRIC SEQUENCES, ARITHMETIC AND GEOMETRIC SITUATIONS, BASE, EFFECT ON GRAPH, END BEHAVIOR, EQUAL DISTANCE OVER EQUAL INTERVALS, EQUAL FACTOR OVER EQUAL INTERVALS, EVEN AND ODD FUNCTIONS, FUNCTIONAL INPUTS, FUNCTION NOTATION, GRAPHS, GRAPHICAL

http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	EFFECTS, INTERCEPTS, INTERVALS, PARAMETERS OF LINEAR/EXP, RECURSIVE AND EXPLICIT FORMULAE, RELATIVE MAXIMUM/MINIMUM, SLOPE, SYMMETRY
ESSENTIAL QUESTIONS:	
HOW DO LINEAR RELATIONSHIPS HELP MODEL NON-LINEAR FUNCTIONS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **F.BF.2**	
	Description: Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.* Unpacked Standard: F.BF.2 Write arithmetic sequences recursively and explicitly, use the two forms to model a situation, and translate between the two forms. F.BF.2 Write geometric sequences recursively and explicitly, use the two forms to model a situation, and translate between the two forms. F.BF.2 Understand that linear functions are the explicit form of recursively-defined arithmetic sequences and that exponential functions are the explicit form of recursively-defined geometric sequences.
	ACT/Anchor Standard: Algebra II Use the fundamental counting principle to count the number of ways an event can happen Use counting techniques, like combinations and permutations, to solve problems (e.g., to calculate probabilities)
	Board Objective: I can use linear relationships to model exponential functions.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Evidence of Success: What exactly do I expect students to be able to do by the end of the lesson, and how will I measure student mastery? That is, deliberate consideration of what performances will convince you (and any outside observer) that your students have developed a deepened (and conceptual)	Connect arithmetic sequences to linear functions and geometric sequences to exponential functions. Students should understand that linear functions are the explicit form of recursively-defined arithmetic sequences and that exponential functions are the explicit form of recursively-defined geometric sequence. ▪ Explain why the recursive formula for and arithmetic sequence uses addition and the explicit formula uses multiplication. ▪ Explain why the recursive formula for a geometric sequence uses multiplication and why the explicit formula uses exponentiation. ▪ Decide when a real world problem models a geometric sequence and write an equation to model the situation. An explicit rule for the n^{th} term of a sequence gives a_n as an expression in the term's position n: a recursive rule gives the first term of a sequence,	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach.

understanding. Students should be able to differentiate between geometric and arithmetic sequences in the lesson closure and on the homework resource sheet Student should be able to write the formulas for a given arithmetic and geometric sequences, both recursively and explicitly in the lesson closure and the homework resource sheet.	and a recursive equation relates a_n to the preceding term(s). Both methods of presenting a sequence describe a_n as a function of n. **Common mistakes and misconceptions:** There may be problems with the use of subscripts to define terms of sequences. While a superscript implies an actual operation, the subscript only differentiates between terms and does not imply a mathematical process. It may be necessary to draw this distinction between these two that are similar in appearance, but different in application. There is often a problem with the use of $d(n\text{-}1)$ vs. $d(n)$ in the explicit formula for arithmetic and the use of r^{n-1} vs. r^n in the explicit formula for geometric. They are necessary to no change it made to the first term (n=1. A class may drive it in another direction and you can use n instead of n-1 as long as the formula uses a_0 instead of a_1, in which case you need to address how to find a_0 Arithmetic $a_n = a_0 + d(n)$ Geometric $a_n = (a_0)(r^n)$ The use of the term geometric can lead students to look for a connection to shapes. The connection seems to be a loose one based on the idea that geometric progressions involve multiplication, which can calculate area which is inherently geometric. If this subject comes up, it may be easier to point out that some words are often used for more than one application.	Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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ESSENTIAL QUESTIONS:	
HOW DO LINEAR RELATIONSHIPS HELP MODEL EXPONENTIAL FUNCTIONS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE:

F.BF.4A

Description: F.BF.4 Find inverse functions. 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, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.

Unpacked Standard:
F.BF.4a Solve a function for the dependent variable and write the inverse of a function by interchanging the values of the dependent and independent variables.

ACT/Anchor Standard:
All QualityCore Mathematics Courses
Use the language of mathematics to communicate increasingly complex ideas orally and in writing, using symbols and notations correctly
Precalculus
Identify, graph, and write equations for inverses and transformations of various functions—including polynomial, rational, radical, absolute value, and trigonometric—with and without technology

Board Objective:

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Evidence of Success: What exactly do I expect students to be able to do by the end of the lesson, and how will I measure student mastery? That is, deliberate consideration of what performances will convince you (and any outside observer) that your students have developed a deepened (and conceptual) understanding. Do the students understand the concept of inverse functions as an equation, graph or set of	Explanations For F.BF.4a focus on linear functions but consider simple situations where the domain of the functions must be restricted in order for the inverse to exist, such as $f(x) = x^2$, $x > 0$. This work will be extended in Algebra 2 to include simple rational, simple radical and simple exponential functions. Solve a function for the dependent variable and write the inverse of a function by interchanging the values of the dependent and independent variable. Students may use graphing calculators or programs, spreadsheets or computer algebra systems to model functions. Instructional Strategies: F.BF.4	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach.

data? Can the students find an inverse given multiple means? Do students recognize that, although a relation may be a function, its inverse may not?	Provide examples of inverses that are not purely mathematical to introduce the idea. For example, given a function that names the capital of a state, f(Ohio) = Columbus. The inverse would be to input the capital city and have the state be the output, such that f^{1}(Denver) = Colorado.	Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO FUNCTIONS HELP TO MODEL, ANALYZE AND PREDICT SITUATIONS?	

GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **F.LE.4**	
	Description: For exponential models, express as a logarithm the solution to $ab^{ct}=d$ where a,c, and d are numbers and the base b Is 2,10,or e; evaluate the logarithm using technology. Unpacked Standard: F.LE.4 Express logarithms as solutions to exponential functions using bases 2, 10, and e. F.LE.4 Use technology to evaluate a logarithm.
	ACT/Anchor Standard: All QualityCore Mathematics Courses Demonstrate the appropriate role of technology (e.g., calculators, software programs) in mathematics (e.g., organize data, develop concepts, explore relationships, decrease time spent on computations after a skill has been established) Algebra II Convert exponential equations to logarithmic form and logarithmic equations to exponential form Precalculus Solve exponential and logarithmic equations and real-world problems involving exponential and logarithmic equations (e.g., compound interest, exponential growth and decay)
	Board Objective:

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one	Students learn terminology that logarithm without a base specified is base 10 and that natural logarithm always refers to base e. Notes: F.LE.1-4 Compare tabular representations of a variety of functions to show that linear functions have a first common difference (i.e., equal differences over equal intervals), while exponential functions do not (instead function values grow by equal factors over equal x-intervals). Apply linear and exponential functions to real-world situations. For example, a person earning $10 per hour experiences a constant rate of	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a

possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem	change in salary given the number of hours worked, while the number of bacteria on a dish that doubles every hour will have equal factors over equal intervals. Provide examples of arithmetic and geometric sequences in graphic, verbal, or tabular forms, and have students generate formulas and equations that describe the patterns. Use a graphing calculator or computer program to compare tabular and graphic representations of exponential and polynomial functions to show how the y (output) values of the exponential function eventually exceed those of polynomial functions. Have students draw the graphs of exponential and other polynomial functions on a graphing calculator or computer utility and examine the fact that the exponential curve will eventually get higher than the polynomial function's graph. A simple example would be to compare the graphs (and tables) of the functions $y = x^2$ and $y = 2x$ to find that the y values are greater for the exponential function when $x > 4$. Help students to see that solving an equation such as $2x = 300$ can be accomplished by entering $y = 22$ and $y = 300$ into a graphing calculator and finding where the graphs intersect, by viewing the table to see where the function values are about the same, as well as by applying a logarithmic function to both sides of the equation. Explore simple linear and exponential functions by engaging in hands-on experiments. For example, students can measure the diameters and related circumferences of several circles and determine a linear function that relates the diameter to the circumference – a linear function with a first common difference. They can then explore the value of an investment when told that the account will double in value every 12 years	balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols

http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	– an exponential function with a base of 2 Common Misconceptions: F.LE.1-4 Students may believe that all functions have a first common difference and need to explore to realize that, for example, a quadratic function will have equal second common differences in a table. Students may also believe that the end behavior of all functions depends on the situation and not the fact that exponential function values will eventually get larger than those of any other polynomial functions.	provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO FUNCTIONS HELP TO MODEL, ANALYZE AND PREDICT SITUATIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.ID.4**	Description: 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. Unpacked Standard: S.ID.4 Identify data sets as approximately normal or not. S.ID.4 Use the mean and standard deviation to fit it to a normal distribution where appropriate. S.ID.4 Use calculators, spreadsheets, and tables to estimate areas under the normal curve. S.ID.4 Interprets areas under a normal curve in context.		
	ACT/Anchor Standard: Precalculus Use the standard normal curve to study properties of normal distributions of data (e.g., give percent of data within a given interval)		

	Board Objective: I can use data to inform decisions and predictions.	
ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom:	While students may have heard of the normal distribution, they may have little prior experience using it to make specific estimates. Build on students' understanding of data distributions to help them see how the normal distribution uses are to make estimates of frequencies (which can be expressed as probabilities). Emphasize that only some data are well described by a normal distribution. Use the 68-95-99.7 rule to estimate the percent of a normal population that falls within 1, 2, or 3 standard deviations of the mean. Recognize that normal distributions are only appropriate for unimodal and symmetric shapes. Students may use spreadsheets, graphing calculators and statistical software, and tables to analyze the fit between a data set and normal distributions and estimate areas under the curve. A statistical process is a problem-solving process consisting of four steps: 1. formulating a statistical question that anticipates variability and can be answered by data 2. designing and implementing a plan that collects appropriate data. 3. analyzing the data by graphical and/or numerical methods. 4. interpreting the analysis in the context of the original question. Graph numerical data on a real number line using dot plots, histograms, and box plots. Analyze the strengths and weakness inherent in each type of plot by comparing different plots of the same data. Describe and give a simple interpretation of a graphical representation of data. Students should already know that the distribution of data can take many forms. It can be	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able

• Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem	symmetric, skewed, distributed uniformly, or follow a normal distribution, also known as a bell curve (think Liberty Bell, not jingle bell), also known as a Gaussian distribution. They don't have to know why a normal distribution has so many different names, although it couldn't hurt. Students should know that we can describe normal distributions as frequency distributions by expressing the data points as percents instead of true values. Instructional Strategies: S.ID.1-4 Have students practice their understanding of the different types of graphs for categorical and numerical variables by constructing statistical posters. Note that a bar graph for categorical data may have frequency on the vertical (student's pizza preferences) or measurement on the vertical (radish root growth over time - days). Measures of center and spread for data sets without outliers are the mean and standard deviation, whereas median and interquartile range are better measures for data sets with outliers. Introduce the formula of standard deviation by reviewing the previously learned MAD (mean absolute deviation). The MAD is very intuitive and gives a solid foundation for developing the more complicated standard deviation measure. Informally observing the extent to which two boxplots or two dot plots overlap begins the discussion of drawing inferential conclusions. Don't shortcut this observation in comparing two data sets. As histograms for various data sets are drawn, common shapes appear. To characterize the shapes, curves are sketched through the midpoints of the tops of the histogram's rectangles. Of particular importance is a symmetric unimodal curve that has specific areas within one, two, and three standard deviations of its mean. It is called the Normal distribution and students need to be able to find areas (probabilities) for various events using tables or a graphing calculator.	to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Common Misconceptions: S.ID.1-4 Students may believe: That a bar graph and a histogram are the same. A bar graph is appropriate when the horizontal axis has categories and the vertical axis is labeled by either frequency (e.g., book titles on the horizontal and number of students who like the respective books on the vertical) or measurement of some numerical variable (e.g., days of the week on the horizontal and median length of root growth of radish seeds on the vertical). A histogram has units of measurement of a numerical variable on the horizontal (e.g., ages with intervals of equal length). That the lengths of the intervals of a boxplot (min,Q1), (Q1,Q2), (Q2,Q3), (Q3,max) are related to the number of subjects in each interval. Students should understand that each interval theoretically contains one-fourth of the total number of subjects. Sketching an accompanying histogram and constructing a live boxplot may help in alleviating this misconception. That all bell-shaped curves are normal distributions. For a bell-shaped curve to be Normal, there needs to be 68% of the distribution within one standard deviation of the mean, 95% within two, and 99.7% within three standard deviations.	

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http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.IC.1**	Description: Understand statistics as a process for making inferences about population parameters based on a random sample from that population. Unpacked Standard: S.IC.1 Explain in context the difference between values describing a population and a sample.		
	ACT/Anchor Standard: Precalculus: Recognize different types of sampling procedures and identify their strengths and limitations Estimate population characteristics based on		

	samples	
	Board Objective: I can evaluate, study and design normal distributions.	
ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Evaluate study design and analyze normal distributions to draw conclusions about populations. Inference Exit Check: Evaluate sample data to make inferences about population parameters. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer	Define populations, population parameter, random sample, and inference. Explain why randomization is used to draw a sample that represents a population well. Recognize that statistics involves drawing conclusions about a population based on the results obtained from a random sample of the population. Example: From a class containing 12 girls and 10 boys, three students are to be selected to serve on a school advisory panel. Here are four different methods of making the selection. I. Select the first three names on the class roll. II. Select the first three students who volunteer. III. Place the names of the 22 students in a hat, mix them thoroughly, and select three names from the mix. IV. Select the first three students who show up for class tomorrow. Which is the best sampling method, among these four, if you want the school panel to represent a fair and representative view of the opinions of your class? Explain the weaknesses of the three you did not select as the best. Solution: Choice III is the best solution in terms of fairness because each of the other methods does not give equal chance of selection to all possible groups of three students. Explanations as to why the others are unfair may include comments such as the following: I. Names beginning with the same letter may belong to the same family or the same ethnic group. II. Volunteers may have special interest in a particular issue on which they want to focus. IV. Prompt students perhaps, would be the more conscientious members of a panel, but they may not be typical of students in the class.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that

Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment	Instructional Strategies: S.IC.1-2 Inferential statistics based on Normal probability models is a topic for Advanced Placement Statistics (e.g., t-tests). The idea here is that all students understand that statistical decisions are made about populations (parameters in particular) based on a random sample taken from the population and the observed value of a sample statistic (note that both words start with the letter "s"). A population parameter (note that both words start with the letter "p") is a measure of some characteristic in the population such as the population proportion of American voters who are in favor of some issue, or the population mean time it takes an Alka Seltzer tablet to dissolve. As the statistical process is being mastered by students, it is instructive for them to investigate questions such as "If a coin spun five times produces five tails in a row, could one conclude that the coin is biased toward tails?" One way a student might answer this is by building a model of 100 trials by experimentation or simulation of the number of times a truly fair coin produces five tails in a row in five spins. If a truly fair coin produces five tails in five tosses 15 times out of 100 trials, then there is no reason to doubt the fairness of the coin. If, however, getting five tails in five spins occurred only once in 100 trials, then one could conclude that the coin is biased toward tails (if the coin in question actually landed five tails in five spins). A powerful tool for developing statistical models is the use of simulations. This allows the students to visualize the model and apply their understanding of the statistical process. Provide opportunities for students to clearly distinguish between a population parameter which is a constant, and a sample statistic which is a variable. Common Misconceptions: S.IC.1-2 Students may believe: That population parameters and sample statistics are one in the same, e.g., that there is no difference between the population mean which is a constant and the sample mean which is a variable.	some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Making decisions is simply comparing the value of one observation of a sample statistic to the value of a population parameter, not realizing that a distribution of the sample statistic needs to be created.	

RESOURCES:	VOCABULARY:
AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html	INFERENCE, MEAN, NORMAL APPROXIMATION, NORMAL DISTRIBUTION, OBSERVATIONAL STUDY, POPULATION PARAMETER, POPULATION PERCENTAGE, RANDOMIZED EXPERIMENT, SAMPLE SURVEY, SPREADSHEET, STANDARD DEVIATION

Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.IC.2**	Description: 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? Unpacked Standard: S.IC.2 Explain how well and why a sample represents the variable of interest from a population. S.IC.2 Demonstrate understanding of the different kinds of sampling methods. S.IC.2 Design simulations of random sampling: assign digits in appropriate proportions for events, carry out the simulation using random number generators and random number tables and explain the outcomes in context of the population and the known proportions.		
	ACT/Anchor Standard: Algebra I Identify patterns of growth (e.g., patterns of exponential growth) in a set of data Find the probability of a simple event Algebra II Find the probability of independent and dependent events		

	Board Objective:	
ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Evaluate study design and analyze normal distributions to draw conclusions about populations. Inference Exit Check: Evaluate sample data to make inferences about population parameters. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions	S.IC.2: Possible data-generating processes include (but are not limited to): flipping coins, spinning spinners, rolling a number cube, and simulations using the random number generators. Students may use graphing calculators, spreadsheet programs, or applets to conduct simulations and quickly perform large numbers of trials. The law of large numbers states that as the sample size increases, the experimental probability will approach the theoretical probability. Comparison of data from repetitions of the same experiment is part of the model building verification process. Example: Have multiple groups flip coins. One group flips a coin 5 times, one group flips a coin 20 times, and one group flips a coin 100 times. Which group's results will most likely approach the theoretical probability? Instructional Strategies: S.IC.1-2 Inferential statistics based on Normal probability models is a topic for Advanced Placement Statistics (e.g., t-tests). The idea here is that all students understand that statistical decisions are made about populations (parameters in particular) based on a random sample taken from the population and the observed value of a sample statistic (note that both words start with the letter "s"). A population parameter (note that both words start with the letter "p") is a measure of some characteristic in the population such as the population proportion of American voters who are in favor of some issue, or the population mean time it takes an Alka Seltzer tablet to dissolve.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course.

• When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	As the statistical process is being mastered by students, it is instructive for them to investigate questions such as "If a coin spun five times produces five tails in a row, could one conclude that the coin is biased toward tails?" One way a student might answer this is by building a model of 100 trials by experimentation or simulation of the number of times a truly fair coin produces five tails in a row in five spins. If a truly fair coin produces five tails in five tosses 15 times out of 100 trials, then there is no reason to doubt the fairness of the coin. If, however, getting five tails in five spins occurred only once in 100 trials, then one could conclude that the coin is biased toward tails (if the coin in question actually landed five tails in five spins). A powerful tool for developing statistical models is the use of simulations. This allows the students to visualize the model and apply their understanding of the statistical process. Provide opportunities for students to clearly distinguish between a population parameter which is a constant, and a sample statistic which is a variable. Common Misconceptions: S.IC.1-2 Students may believe: That population parameters and sample statistics are one in the same, e.g., that there is no difference between the population mean which is a constant and the sample mean which is a variable. Making decisions is simply comparing the value of one observation of a sample statistic to the value of a population parameter, not realizing that a distribution of the sample statistic needs to be created.	CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
RESOURCES:		VOCABULARY:

AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	INFERENCE, MEAN, NORMAL APPROXIMATION, NORMAL DISTRIBUTION, OBSERVATIONAL STUDY, POPULATION PARAMETER, POPULATION PERCENTAGE, RANDOMIZED EXPERIMENT, SAMPLE SURVEY, SPREADSHEET, STANDARD DEVIATION
ESSENTIAL QUESTIONS:	

HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **S.IC.3**	Description: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. Unpacked Standard: S.IC.3 Identify situations as either sample survey, experiment, or observational study. Discuss the appropriateness of each one's use in contexts with limiting factors. S.IC.3 Design or evaluate sample surveys, experiments and observational studies with randomization. Discuss the importance of randomization in these processes.
	ACT/Anchor Standard: Precalculus: Recognize different types of sampling procedures and identify their strengths and limitations Estimate population characteristics based on samples
	Board Objective: I can design and evaluate sample surveys, experiments and observational studies with randomization to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
S.IC.3: Students should be able to: Explain techniques/ applications for randomly selecting subjects from a population and how those	Connections: S.IC.3-6 In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed informally through simulation as meaning a result that is unlikely to have	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical

techniques/applications differ from those used to randomly assign existing subjects to control groups or experimental groups in a statistical experiment.	occurred solely as a result of random selection in sampling or random assignment in an experiment. Using simulation to estimate probabilities is a part of the Grade 7 curriculum, as is introductory understanding of using random sampling to draw inferences about a population. Explanations and Examples: S.IC.3 Identify situations as either sample survey, experiment, or observational study. Discuss the appropriateness of each one's use in contexts with limiting factors. Describe the purposes and differences of each. Design or evaluate sample surveys, experiments and observational studies with randomization. Discuss the importance of randomization in these processes. Students should be able to explain techniques/applications for randomly selecting study subjects from a population and how those techniques/applications differ from those used to randomly assign existing subjects to control groups or experimental groups in a statistical experiment. In statistics, and observational study draws inferences about the possible effect of a treatment on subjects, where the assignment of subjects into a treated group versus a control group is outside the control of the investigator (for example, observing data on academic achievement and socio-economic status to see if there is a relationship between them). This is in contrast to controlled experiments, such as randomized controlled trials, where each subject is randomly assigned to a treated group or a control group before the start of the treatment. Instructional Strategies: S.IC.3-6 This cluster is is designed to bring the four-step statistical process to life and help students understand how statistical decisions are made. The mastery of this cluster is fundamental to the goal of creating a statistically literate citizenry. Students will need to use all of the data analysis, statistics, and probability concepts covered to date to develop a deeper understanding of inferential reasoning.	approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show

	Students learn to devise plans for collecting data through the three primary methods of data production: surveys, observational studies, and experiments. Randomization plays various key roles in these methods. Emphasize that randomization is not a haphazard procedure, and that it requires careful implementation to avoid biasing the analysis. In surveys, the sample selected from a population needs to be representative; taking a random sample is generally what is done to satisfy this requirement. In observational studies, the sample needs to be representative of the population as a whole to enable generalization from sample to population. The best way to satisfy this is to use random selection in choosing the sample. Students like to ask each other questions, but constructing meaningful, unbiased survey questions is not easy. Begin by critiquing published surveys before having students design their own. In comparative experiments between two groups, random assignment of the treatments to the subjects is essential to avoid damaging problems when separating the effects of the treatments from the effects of some other variable, called confounding. In many cases, it takes a lot of thought to be sure that the method of randomization correctly produces data that will reflect that which is being analyzed. For example, in a two-treatment randomized experiment in which it is desired to have the same number of subjects in each treatment group, having each subject toss a coin where Heads assigns the subject to treatment A and Tails assigned the subject to treatment B will not produce the desired random assignment of equal-size groups. The advantage that experiments have over surveys and observational studies is that one can establish causality with experiments. Common Misconceptions: S.IC.3-6 ▪ Students may believe: ▪ That collecting data is easy; asking friends for their opinions is fine in determining what everyone thinks.	visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

	▪ That causal effect can be drawn in surveys and observational studies, instead of understanding that causality is in fact a property of experiments. ▪ That inference from sample to population can be done only in experiments. They should see that inference can be done in sampling and observational studies if data are collected through a random process.	

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http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.IC.4**	Description: S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. Unpacked Standard S.IC.4 Use sample means and sample proportions to estimate population values. S.IC.4 Conduct simulations of random sampling to gather sample means and sample proportions. Explain what the results mean about variability in a population and use results to calculate margins of error for these estimates.		
	ACT/Anchor Standard: Precalculus: Recognize different types of sampling procedures and identify their strengths and limitations Estimate population characteristics based on samples		
	Board Objective:		

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES

Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings,	Standard 4 addresses estimation of the population proportion parameter and the population mean parameter. Data need not come from just a survey to cover this topic. A margin-of-error formula cannot be developed through simulation, but students can discover that as the sample size is increased, the empirical distribution of the sample proportion and the sample mean tend toward a certain shape (the Normal distribution), and the standard error of the statistics decreases (i.e. the variation) in the models becomes smaller. The actual formulas will need to be stated. For S.IC.4-5 focus on the variability of results from experiments. Focus on statistics as a way of dealing with, not eliminating, inherent randomness. Calculate the sample mean and proportion. Use sample means and sample proportions to estimate population values. Defend the statement, "The population mean or proportion is close to the sample mean or proportion when the sample is randomly selected and large enough to represent the population well." Infer that the population mean or proportion is equal to the sample mean or proportion and conduct simulation to determined which sample results are typical of this model and which results are considered outliers (possible, but unexpected). Choose an appropriate margin of error for the sample mean or proportion and create a confidence interval based on the results of the simulation conducted. Determine how often the true population mean or proportion is within the margin of error of each sample mean or proportion. Pose a question regarding the mean or proportion of a population, use statistical	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come

Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	techniques to estimate the parameter, and design an appropriate product to summarize the process and report the estimate. Explain what the results mean about variability in a population and use results to calculate the error for these estimates. Students may use computer generated simulation models based upon the results of sample surveys to estimate population statistics and margins of error. Students should understand how the mean, proportion, and margin of error can all be gleaned from a sample survey. In order to do that, they have to know what these wonderful things are. The **population mean** is the average value of the parameter for the whole population, and is expressed as μ. Students should know that it's nearly impossible to find the true value of μ, so we use the mean of our sample to estimate it. The larger of a sample we have, the closer we'll get to μ. We mean it. Rather than finding μ, it may just be better to find the population's **proportion**. Population proportions can be given as point estimates (single values) or intervals (a range of values). That is, we can say that 80% of residents prefer candidate X, or that 75 - 85% prefer candidate X. Students should know when it's appropriate to use each one, depending on the accuracy of the study and the variability of the numbers. Our sample estimate, randomly chosen, is nothing more than an estimate of our population mean or proportion. That means there will always be some **margin of error** involved. The only way we won't have a margin of error is if we had all the money and time in the world (yes, please!) to sample everyone in the population.	first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.
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ESSENTIAL QUESTIONS:	

HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **S.IC.5**	Description: Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. Unpacked Standard: S.IC.5 Evaluate effectiveness and differences in two treatments based on data from randomized experiments. Explain in context. S.IC.5 Use simulations to generate data simulating application of two treatments. Use results to evaluate significance of differences.
	ACT/Anchor Standard: Precalculus Use the standard normal curve to study properties of normal distributions of data (e.g., give percent of data within a given interval) Recognize different types of sampling procedures and identify their strengths and limitations Estimate population characteristics based on samples
	Board Objective: I can use data to compare two treatments to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often	For S.IC.4-5 focus on the variability of results from experiments. Focus on statistics as a way of dealing with, not eliminating, inherent randomness. ▪ Calculate the sample mean and standard deviation of the two treatment groups and the difference of the means. ▪ Conduct a simulation for each treatment group using the sample results as the parameters for the distributions.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of

requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL	▪ Calculate the difference of means for each simulation and represent those differences in a histogram. ▪ Use the results of the simulation to create a confidence interval for the difference of means. ▪ Use the confidence interval to determine if the parameters are significantly different based on the original difference of means. Students may use computer generate simulation models to decide how likely it is that observed differences in a randomized experiment are due to chance. Treatment is a term used in the context of an experimental design to refer to any prescribed combination of values of explanatory variables. For example, one wants to determine the effectiveness of week killer. Two equal pieces of land in a neighborhood are treated, one with a placebo and one with weed killer to determine whether there is a significant difference in effectiveness in eliminating weeds. Whatever way we spin it, statistics is about numbers. So obviously, it makes sense that statisticians use a lot of numerical data (height, weight, age, etc.), but even that gets too easy after a while. Data that isn't represented numerically is known as categorical data (eye color, hair color, sex, etc.). Although it may seem like there isn't much we can do with categorical data (after all, how can we analyze a person's brown eye color?), statisticians would beg to differ. Well, there's a 92% chance they'd beg to differ, anyway. Students should know what to do with categorical data and how to analyze it. Students should be able to analyze data from two different categories.	tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the

During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf		concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs	INFERENCE, MEAN, NORMAL APPROXIMATION, NORMAL DISTRIBUTION, OBSERVATIONAL STUDY, POPULATION PARAMETER, POPULATION PERCENTAGE, RANDOMIZED EXPERIMENT, SAMPLE SURVEY, SPREADSHEET, STANDARD DEVIATION

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ESSENTIAL QUESTIONS:	
HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE:	Description: Evaluate reports based on data. Unpacked Standard: S.IC.6 Read and explain in context data from outside reports.		

S.IC.6	ACT/Anchor Standard: All QualityCore Mathematics Courses Make mathematical connections among concepts, across disciplines, and in everyday experiences Algebra I Interpret data from line, bar, and circle graphs, histograms, scatterplots, box-and-whisker plots, stem-and-leaf plots, and frequency tables to draw inferences and make predictions Board Objective: I can read and explain data in context.	
ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class,	S.IC.6: Explanations can include but are not limited to sample size, biased survey sample, interval scale, unlabeled scale, uneven scale, and outliers that distort the line-of-best-fit. In a pictogram the symbol scale used can also be a source of distortion. As a strategy, collect reports published in the media and ask students to consider the source of the data, the design of the study, and the way the data are analyzed and displayed. Example: • A reporter used the two data sets below to calculate the mean housing price in Arizona as $629,000. Why is this calculation not representative of the typical housing price in Arizona? • King River area {1.2 million, 242000, 265500, 140000, 281000, 265000, 211000} • Toby Ranch homes {5million, 154000, 250000, 250000, 200000, 160000, 190000} ▪ Read and explain in context data from outside reports. ▪ Identify the variables as quantitative or categorical. ▪ Describe how the data was collected. ▪ Indicate any potential biases or flaws. ▪ Identify inferences the author of the report made from sample data. ▪ Write or present a summary of a data-based report addressing the sampling techniques used, inferences made, and any flaws or biases. Students should understand that even though statistics has more charts, tables,	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach.

post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	and numbers than your students might think is humanly possible, that's not all statistics encompasses. There are meanings behind the numbers. Yes, we're talking about context. Students must evaluate their knowledge and understanding of statistical principles in the proper context. Students must be able to read an analysis or report and actually decipher the intent, the meaning, and the significance of what's in front of them. It sounds easy, but critical thinking isn't! It can only occur once the fundamentals are mastered and knowledge can be used to actually critique something. Here are some good questions to ask the class and facilitate understanding. ▪ What is the purpose of the study? ▪ How did the authors go about collecting data? ▪ Were the collection methods appropriate for this particular study? ▪ Were they randomized? ▪ Were the significance levels appropriate? ▪ What was the null hypothesis? ▪ What was the alternative hypothesis? ▪ Were the correct statistical tests used for the data? ▪ Was the data fully presented? ▪ Who were the study participants? ▪ Who funded the study? Can bias arise from that? ▪ What were the results? ▪ Why are the results significant even if there were no significant findings? Aside from asking questions about already completed studies, students can come up with hypothetical studies to help develop a deeper understanding of the core concepts. That way, students can choose topics that interest them and think about how they would go about testing aspects of these topics to ensure statistical	Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the

	validity.	mathematical skills they master.

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ESSENTIAL QUESTIONS:	

HOW DO DATA INTERPRETATIONS HELP DEVELOP INFORMED DECISIONS AND PREDICTIONS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **S.CP.1**	Description: 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"). Unpacked Standard: S.CP.1 Define a sample space and events within the sample space. Identify subsets from sample space given defined events, including unions, intersections and complements of events.
	ACT/Anchor Standard: Algebra II Use unions, intersections, and complements to find probabilities
	Board Objective:

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps*	Connections: S.IC.1-5 Beginning work with categorical variables and two-way tables occurs in Grade 8. It is likely that these standards will need to be revisited on a deeper level. Build on work with two-way tables from S.ID.5 to develop understanding of conditional probability and independence. Define a sample space and events within the sample space.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and

Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During	Establish events as subsets of a sample space. Use correct set notation, with appropriate symbols, to identify sets and subsets. Define union, intersection, and complement. Draw Venn diagrams that show relationships between sets within a sample space. Instructional Strategies: S.CP.1-5 The Standard for Mathematical Practice, precision is important for working with conditional probability. Attention to the definition of an event along with the writing and use of probability function notation are important requisites for communication of that precision. For example: Let A: Female and B: Survivor, then P(A|B) =. The use of a vertical line for the conditional "given" is not intuitive for students and they often confuse the events B|A and A|B. Moreover, they often find identifying a conditional difficult when the problem is expressed in words in which the word "given" is omitted. For example, find the probability that a female is a survivor. The standard Make sense of problems and persevere in solving them also should be employed so students can look for ways to construct conditional probability by formulating their own questions and working through them such as is suggested in standard 4 above. Students should learn to employ the use of Venn diagrams as a means of finding an entry into a solution to a conditional probability problem. It will take a lot of practice to master the vocabulary of "or," "and," "not" with the mathematical notation of union (U), intersection (∩), and whatever notation is used for complement. The independence of two events is defined in Standard 2 using the intersection. It is far more intuitive to introduce the independence of two events in terms of conditional probability (stated in Standard 3), especially where calculations can be performed in two-way tables.	symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help

Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	The Standards in this cluster deliberately do not mention the use of tree diagrams, the traditional way to treat conditional probabilities. Instead, probabilities of conditional events are to be found using a two-way table wherever possible. Using a two-way table begins with calculation of marginal probabilities. Conditional probabilities and determination of independent events follow. However, tree diagrams may be a helpful tool for some students. The difficulty is realizing that the second set of branches are conditional probabilities. There are many good problems that can appeal to students' sensitivities of fairness and justice in society. Students can formulate their questions that concern how certain characteristics of their own identity groups are viewed by society and understand how conditional probability is often misunderstood by society as whole. Common Misconceptions: S.CP.1-5 Students may believe: That multiplying across branches of a tree diagram has nothing to do with conditional probability. That independence of events and mutually exclusive events are the same thing.	students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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ESSENTIAL QUESTIONS:	
HOW DOES PROBABILITY HELP TO DEVELOP INFORMED DECISIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE:	Description: 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. Unpacked Standard:		

S.CP.2	S.CP.2 Identify two events as independent or not. Explain properties of Independence and Conditional Probabilities in context and simple English.
	ACT/Anchor Standard: Algebra II Find the probability of independent and dependent events
	Board Objective: I can evaluate probability models to become a better problem solver.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to	Define and identify independent events. Explain properties of Independence and Conditional Probabilities. Use appropriate probability notation for individual events as well as their intersection (joint probability). Calculate probabilities for events, including joint probabilities, using various methods (e.g., Venn diagrams, frequency table). Compare the product of probabilities for individual events ($P(A) \cdot P(B)$) with their joint probability ($P(A \cap B)$). Understand that independent events satisfy the relationship $P(A) \cdot P(B) = P(A \cap B)$. Predict if two events are independent, explain reasoning and check. Examples: ▪ When rolling two number cubes: ▪ What is the probability of rolling a sum that is greater than 7? ▪ What is the probability of rolling a sum that is odd? ▪ Are the events, rolling a sum greater than 7, and rolling a sum that is odd, independent? Justify your response.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach.

consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write	Roll a pair of dice 100 times and keep track of the outcomes. Find pairs of events that are independent and pairs that are not. Justify your conclusions. (For example, the probability of rolling doubles and the probability of rolling 7 vs. the probability of rolling doubles and the probability of rolling a sum that is less than 4). "Give me liberty, or give me death!" Learning about the independence of events isn't always as exciting as learning about the independence of the American colonists. You'll certainly grab the attention of the students if you slam your fist on your desk at the beginning of this lesson, shouting the words of Patrick Henry. With a sample space, we can take advantage of probabilities for the sample space. There are two ideas here that students should learn. The first is the idea that two events are not necessarily independent. For example, the probability of you slamming your fist on the desk could be related to the probability of your coffee spilling all over the students graded homework. For clumsier teachers, these probabilities may not be related. The first idea is one that draws upon assumptions about relationships. Students should be able to recognize that two events are not necessarily related, even if they appear to be. At least, they should be able to recognize this under the umbrella of statistics. Just because you give a group of third graders vanilla ice cream cones doesn't mean they are happy. Maybe they're happy because it's Friday or because Arbor Day is a week away. (Honestly, who doesn't love Arbor Day?) You want to relate to the students that there are many possible effects that on an outcome, and statistics are a useful tool to determine which events are independent. How do we discern the clumsy teachers from the over-animated ones? We need a statistics litmus test—say that five times fast—to help us out. If we have statistics exploring spilled coffee and fist slamming in math teachers, we can use the probabilities to test the independence of the two events. This is the second idea the students should learn.	Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the

After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	On a given day, the probability of math teachers in Virginia spilling their coffee, event C, is P(C) = 0.25, the probability of slamming their fists, event F, is P(F) = 0.10, and the probability of both occurring, event B, is P(B) = 0.025. Since P(C) × P(F) = 0.025 = P(B), we can conclude that the C and F are independent events. The Virginian math teachers surveyed aren't so zealous with their fist-slamming as to spill their coffee. It turns out that some of the teachers must just be klutzes. When a similar survey was completed in Ohio, probabilities P(C) = 0.32, P(F) = 0.09, and P(B) = 0.08 were found. P(C) × P(F) = 0.0288, not P(B). We know events C and F are not independent in the group of sampled Ohioan math teachers. The spirit of Patrick Henry appears to be roaring in their bellies. Feel free to have fun with this lesson. Make an outrageous claim that all carnivorous dinosaurs prefer to wear purple, polka-dotted jumpsuits. Use the probabilities of each to prove or disprove your outrageous claim. This will open the minds of the students to the idea that things aren't always what they seem. Then teach them this probabilistic tool to decide for themselves.	mathematical skills they master.

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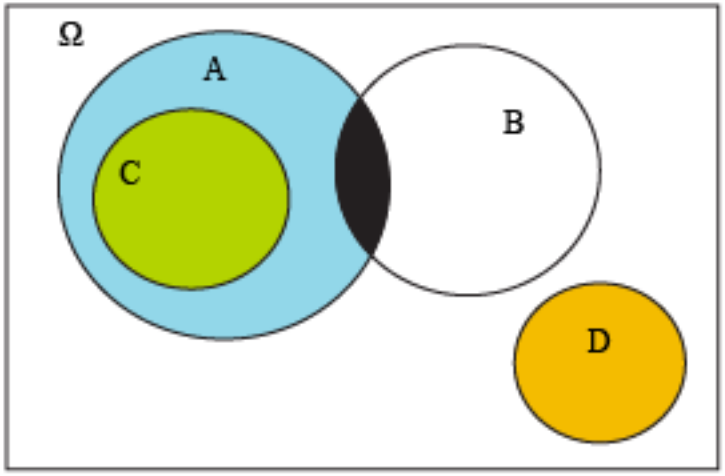
HOW DOES PROBABILITY HELP TO DEVELOP INFORMED DECISIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE:	Description: Understand the conditional probability of A given B as P (A and B)/P (B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.		

S.CP.3	Unpacked Standard: S.CP.3 Define and calculate conditional probabilities. Use the Multiplication Principal to decide if two events are independent and to calculate conditional probabilities.
	ACT/Anchor Standard: Algebra II Find the probability of independent and dependent events Solve problems involving conditional probability
	Board Objective: I can use probability to make informed decisions.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to	You're taking a weeklong vacation. You booked a quiet, lakeside cabin, nestled at the foot of the unadulterated mountains a few hours from home. Although you have a good idea of where you're going, you still lean on your GPS—you named her Geepas—to get you safely to your respite from the world. As you get within a few miles of the cabin, Geepas takes you down a dingy road with a tree canopy that blocks out the sunlight. Soon, the pavement turns to dirt, and you arrive at a dead end. You know you're close, but you're lost in a foreign wilderness. Frantically, you search for a map, any sign of civilization, or a beam of sunlight that can point you in the right direction. Geepas has failed you. This is how students are likely to feel the first time you teach them conditional probability. You will be their Geepas, leading them down a path to follow. If you aren't careful about how you present the ideas, you many leave them stranded. Conditional probability is really about asking a simple question: now that event A has occurred, what is the probability that event B will occur? The Venn diagram in the image depicts this idea. Let's say we already know that event A has occurred. The possible outcomes for event B are those shaded in black. Likewise, the possible outcomes for event C are those shaded in green.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style

2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	 Now you can ask the students, "Once event A has already occurred, are the possible outcomes for event D those shaded in orange?" Many students may jump up with enthusiasm, yelling, "Yes! Orange!" Geepas led those students astray. The correct answer is that there are no possible outcomes for event D given that event A has already occurred. It's all right to lead them astray, so long as you can lead them back on the right track. Before the battery life runs out, preferably. We want to break down what happened here. We already know that event A occurred. It happened. It's a fact. Instead of all possible outcomes being in the space Ω, all possible outcomes are in the blue space. Since A occurred, what is the probability that event B occurred? This is called P(B|A), read "the probability of B given A." We have fewer outcomes to choose from than before, now that A has occurred. The probability of B occurring should reflect that. Now that you've drawn the distinction for the students, you can present the formula on how to calculate P(B|A) for the students:	to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols

		proficiently with many of the mathematical skills they master.

RESOURCES:	VOCABULARY:
AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	COMBINATIONS, COMPLEMENTS, CONDITIONAL PROBABILITY, COMPLEMENTS, EVENTS, INDEPENDENT EVENTS, INTERSECTIONS, PERMUTATIONS, SAMPLE SPACE, SUBSETS, UNIONS

ESSENTIAL QUESTIONS:
HOW DOES PROBABILITY HELP TO DEVELOP INFORMED DECISIONS?

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**

CODE: **S.CP.4**	Description: Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two- way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results. Unpacked Standard: S.CP.4 Construct and interpret two-way frequency tables of data for two categorical variables. Calculate probabilities from the table. Use probabilities from the table to evaluate independence of two variables.
	ACT/Anchor Standard: Algebra I Interpret data from line, bar, and circle graphs, histograms, scatterplots, box-and-whisker plots, stem-and-leaf plots, and frequency tables to draw inferences and make predictions Distinguish between independent and dependent events Algebra II Find the probability of independent and dependent events Solve problems involving conditional probability
	Board Objective: I can assess the probability of a specified event given a series of conditions.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES

Conditional Probability Exit Check: Assess the probability of a specified event given a series of conditions. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom:	S.CP.4: Students may use spreadsheets, graphing calculators, and simulations to create frequency tables and conduct analyses to determine if events are independent or determine approximate conditional probabilities. ▪ Determine when a two-way frequency table is an appropriate display for a set of data. ▪ Collect data from a random sample. ▪ Construct a two-way frequency table for the data using the appropriate categories for each variable. ▪ Calculate probabilities from the table. Use probabilities form the table to evaluate independence of two variables. ▪ Pose a question for which a two-way frequency is appropriate, use statistical techniques to sample the population, and design an appropriate product to summarize the process and report the results. ▪ Students may use spreadsheets, graphing calculators, and simulations to create frequency tables and conduct analyses to determine if events are independent or determine approximate conditional probabilities. It's the most common dilemma any amateur baker faces: now that we have chocolate cake batter mixed and ready to go, do we make individual cupcakes or one big cake for the room to share? Of course, by the time you've gotten to this step, you've already solved the problem of listing ingredients, doubling the recipe for the ginormous party, and being careful not to mistake the teaspoon of salt for a tablespoon. (Whew!) When it comes to statistics, we need a way to list the ingredients of our sample population. Two-way frequency tables give us a clean way to list statistics and solve problems that will feed the masses with the knowledge they desire. When constructing two-way frequency tables, we are just reporting raw data. Students probably won't find it difficult. Just fill in the numbers as they are reported. Construct a matrix where one set of comparison statistics, say yellow, chocolate, strawberry, and angel food, are on one axis, and another set, cupcake and three-tiered, are on the other axis. It's useful to include total columns and rows as well, where they are just sums of all the	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come

• Assign the right amount of “routine” homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I	outcomes of each comparison statistic. If they are not there, teach the students to do the arithmetic themselves before they use the table. **Sample Space of the Fourth Grade's Preferences for Cake** |	Yellow	Chocolate	Strawberry	Angel Food	Total
---	---	---	---	---	---
Cupcake	12	16	17	5	50
Three-Tiered	16	22	6	17	61
Total	28	38	23	22	111 | What we've just done is construct another version of the sample space. Like the Venn diagram, this is just another tool to represent the data in a way we can make use of it. It's the cupcake of statistics, where the Venn diagram is the three-tiered chocolate volcano cake. Students should understand that they are both useful in their own ways. With our recipe we need to bake up some statistics. Ask the students some simple questions about your example table. Here, we could ask, "What is the probability that a fourth grader prefers cupcakes over three-tiered cakes?" or, "What is the probability that a student prefers chocolate cupcakes from over anything else?" Mixing up the questions for students to see the different ways the table can be used will help the students see the utility of the tables. The students have constructed two-way tables, and they know how to calculate probabilities from the tables in every way possible. The last step is to apply the formula they already know for conditional probability. From this formula, they can easily determine the independence or dependence of two events, for instance, whether chocolate cake preference affects cupcake preference. One of the most difficult things about mathematics is how to determine when a formula is applicable and when it is not. Students struggle all of the time in mathematically-based	first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

%20Assessments.pdf	sciences and in mathematics with this concept. They have determined probabilities, so all they need to do is to apply the formula to the situation. Reinforcing this concept with a Venn diagram for your chosen example could prove helpful. Students should be able to recognize that, regardless of visualization, the formula is applicable to probabilities. Like baking, it doesn't matter what tools they use to mix the batter. As long as they used the right ingredients, they should still end up with a delicious treat.	

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Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
HOW DOES PROBABILITY HELP TO DEVELOP INFORMED DECISIONS?	

GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.CP.5**	Description: Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer. Unpacked Standard: S.CP.5 Recognize and explain the concepts of independence and conditional probability in everyday situations.		
	ACT/Anchor Standard: Algebra II Solve problems involving conditional probability		
	Board Objective: I can solve problems using conditional probability.		

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Conditional Probability Exit Check: Evaluate a conditional probability	Illustrate the concept of conditional probability using everyday examples of dependent events.	Teach to multiple modalities: Say it; write it, have students write it

scenario to determine the outcomes and establish independence of the events. Conditional Probability Exit Check: Assess the probability of a specified event given a series of conditions. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard	Illustrate the concept of independence using everyday examples of independent events. Interpret conditional probabilities and independence in context. Are you hungry because you thought about double-fudge cupcakes, or did you think about double-fudge cupcakes because you were hungry? It's all together possible that you have an insatiable appetite for cupcakes, and being hungry had absolutely nothing to do with it. This modern chicken-or-egg argument is just one question that could be answered using a statistical approach. We could use a set of sample data to determine conditional probabilities from which we could determine the independence or dependence of the two events. There are many different questions like this we could ask. The goal is two-fold. First, the students should be able to recognize these key concepts in terms of everyday language and situations. We want to engage students to think critically about relationships between two otherwise unrelated things. Just because a cause-and-effect relationship appears to exist doesn't mean there is one necessarily. In our example, your hunger may be entirely unrelated to thinking about cupcakes. If they are related, did the hunger cause the thought or did the thought cause the hunger? Next, the students should be able to explain these relationships. The students should first be able to parse the information into data that can be represented by two-way probabilities. The information can be represented using Venn diagrams or two-way frequency tables. Using the resources they've built, students can apply the knowledge they have of probabilities and independence of events to explore the relationships in question.	and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be

• Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Let's think back to your seemingly inexplicable hunger. To answer your question more generally, you could survey 100 math teachers across your school district. You could ask the teachers if they prefer cupcakes or grilled cheese, as well as if they are hungry or not hungry. From your results, you could create a two-way table. You could ask the same questions in the opposite order, as well, and create a similar two-way table. Once you have your two-way table, you can calculate individual probabilities. From those, you can get conditional probabilities, and from those, you can estimate if two events are independent or dependent. Since you have two tables to look at, you could see if the results change noticeably if they were asked if they were hungry or not before being asked if they prefer cupcakes or grilled cheese. Say the probability of you preferring a cupcake went down significantly if someone asked if you were hungry first. What would it say about which came first: hunger or the cupcake? The most important key in this lesson is to teach students to think critically about the questions they want answers to. From this, students should be able to link their questions to the types of data they will gather. Finally, they should be able to assemble the data and infer relationships from the data using their knowledge about probabilities.	used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	
ESSENTIAL QUESTIONS:	
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GRADE: Grade: Algebra II	SUBJECT: Math	STRAND:	MONTH(S) TAUGHT:

CODE: **S.CP.6**	Description: S.CP.6 Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model. Unpacked Standard: S.CP.6 Calculate conditional probabilities using the definition: "the conditional probability of A given B as the fraction of B's outcomes that also belong to A". Interpret the probability in context.
	ACT/Anchor Standard: Algebra II Solve problems involving conditional probability
	Board Objective: I can solve problems using conditional probability.

ASSESSMENTS:	CONCEPT NOTES:	STRATEGIES
Conditional Probability Exit Check: Evaluate a conditional probability scenario to determine the outcomes and establish independence of the events. Conditional Probability Exit Check: Assess the probability of a specified event given a series of conditions. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps*	Instructional Strategies: S.CP.6-7 Identifying that a probability is conditional when the word "given" is not stated can be very difficult for students. For example, if a balanced tetrahedron with faces 1, 2, 3, 4 is rolled twice, what is the probability that the sum is prime (A) of those that show a 3 on at least one roll (B)? Whether what is asked for is P(A and B), P(A or B), or P(A|B) can be problematic for students. Showing the outcomes in a Venn Diagram may be useful. The calculation to find the probability that the sum is prime (A) given at least one roll shows 3 (B) is to count the elements of B by listing them if possible, namely in this example, there are 7 paired outcomes (31, 32, 33, 34, 13, 23, 43). Of those 7 there are 4 whose sum is prime (32, 34, 23, 43). Hence in the long run, 4 out of 7 times of rolling a fair tetrahedron twice, the sum of the two rolls will be a prime number under the condition that at least one of its rolls shows the digit 3. Note that if listing outcomes is not possible, then counting the outcomes may	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that

Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write	require a computation technique involving permutations or combinations. In the above example, if the question asked were what is the probability that the sum of two rolls of a fair tetrahedron is prime (A) or at least one of the rolls is a 3 (B), then what is being asked for is P(A or B) which is denoted as P(A Ç B) in set notation. Again, it is often useful to appeal to a Venn Diagram in which A consists of the pairs: 11, 12, 14, 21, 23, 32, 34, 41, 43; and B consists of 13, 23, 33, 43, 31, 32, 34. Adding P(A) and P(B) is a problem as there are duplicates in the two events, namely 23, 32, 34, and 43. So P(A or B) is 9/16 + 7/16 – 4/16 = 12/16 or 3/4, so 3/4th of the time, the result of rolling a fair tetrahedron twice will result in the sum being prime, or at least one of the rolls showing a 3, or perhaps both will occur. Common Misconceptions: S.CP.6-7 Students may believe: ▪ That the probability of A or B is always the sum of the two events individually. ▪ That the probability of A and B is the product of the two events individually, not realizing that one of the probabilities may be conditional. Do you remember the last time you went out for pizza with a couple of friends? The three of you sat there laughing and eating away at the 8-slice, New York style, pepperoni pizza in front of you. You finished up your second slice and grabbed a sip of soda. At the same time, Billy finished his second slice. Realizing what was going on, Bob stuffed this remaining second slice into his mouth. Only two slices remained for the three of you. An all-out brawl was about to erupt. As the pacifist of the group, you grabbed a plastic knife and cut the 2 slices into three equal portions, narrowly averting the mozzarella melee. Always the resourceful one. But what if you hadn't been so resourceful? Before you started eating, what is the probability you would have exactly three slices of pizza, P(A)? Once you've	doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and

After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	each had two slices, what is the probability you'd have exactly three slices, P(A|B)? (Here, event B is you each have had 2 slices, and there are only two left.) Students should already recognize that these probabilities, P(A) and P(A|B) are different, but they may not necessarily understand why.	efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

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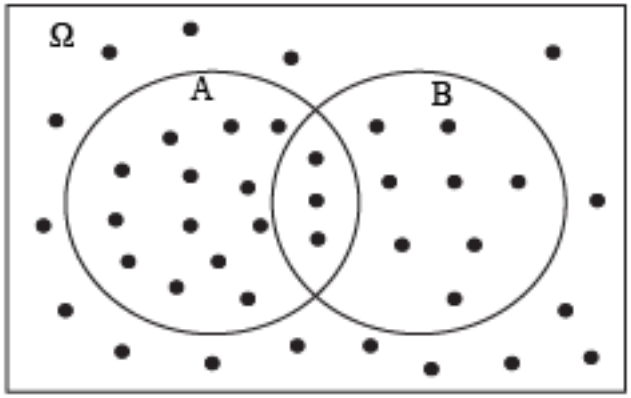
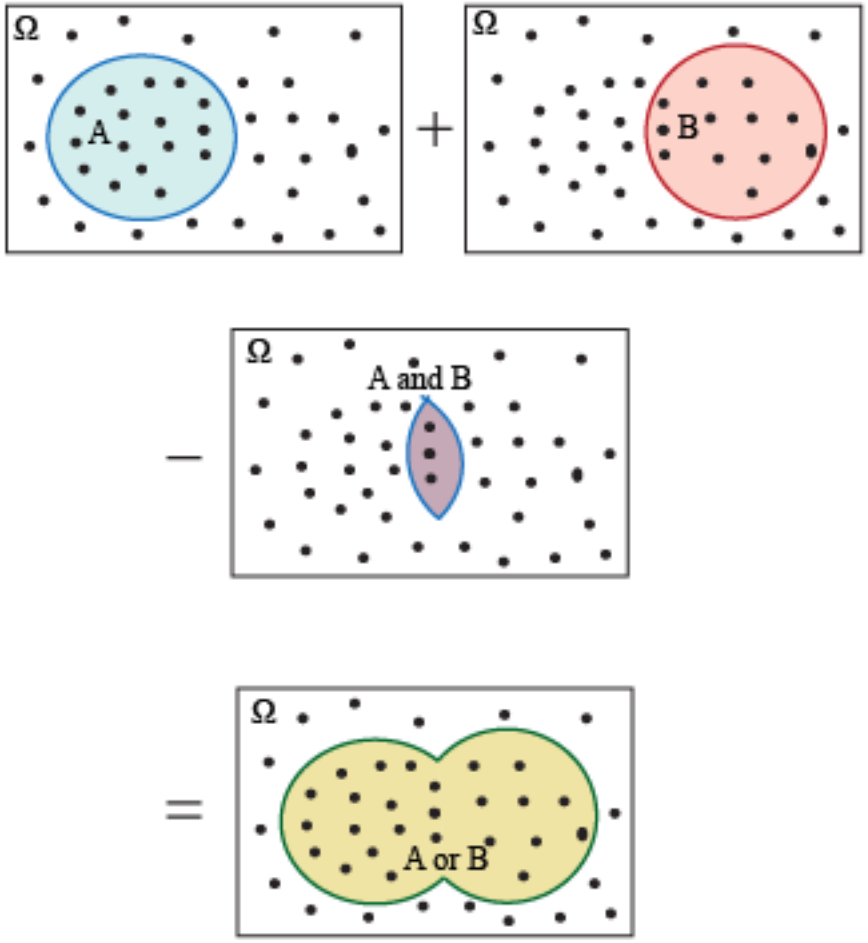
GRADE: Grade: Algebra II	**SUBJECT: Math**	**STRAND:**	**MONTH(S) TAUGHT:**
CODE: **S.CP.7**	Description: Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. Unpacked Standard: S.CP.7 Identify two events as disjoint (mutually exclusive). Calculate probabilities using the Addition Rule. Interpret the probability in context.		
	ACT/Anchor Standard: Algebra II Find the probability of independent and dependent events		
	Board Objective: I can find the probability of independent and dependent events.		
ASSESSMENTS:	CONCEPT NOTES:		STRATEGIES

Conditional Probability Exit Check: Evaluate a conditional probability scenario to determine the outcomes and establish independence of the events. Conditional Probability Exit Check: Assess the probability of a specified event given a series of conditions. Depth of Knowledge: Level 1: Recall — Asks students to recall a fact, information, or a procedure Level 2: Basic Reasoning — Asks students to use information or conceptual knowledge, often requiring two or more steps* Level 3: Complex Reasoning — Asks students to use complex thinking and consideration of more than one possible approach and answer Level 4: Extended Reasoning — Asks students to use strategic thinking to consider, plan, analyze, etc., usually resulting in a finished product	Two wrongs don't make a right, but in some cases, adding two rights can make a wrong, especially in the world of probability. Students should already know the multiplication rule for probability using the idea of conditional probabilities. Now, they need an addition rule. If we have two events A and B with probabilities P(A) = 0.5 and P(B) = 0.75, then P(A) + P(B) = 1.25 should be a probability, too. But because probabilities must be in the interval [0, 1], a probability of 1.25 has no meaning. How can that be? If we look at a Venn diagram of events A and B, P(A) is the number of outcomes in circle A divided by the total number of outcomes. P(B) is the total number of outcomes in circle B divided by the total number of outcomes. The problem is that P(A) and P(B) share some outcomes in common. When the two probabilities are added together, we've double-counted those probabilities.  See? Two rights make a wrong. (But three rights make a left!) We've just accounted for those probabilities twice, so we can apply a simple fix to the formula. Just subtract out the number of outcomes shared between A and B.	Teach to multiple modalities: Say it; write it, have students write it and do it (as much as possible). Balance the mathematical presentation with numerical approaches (mostly with use of tables), graphic approaches, and symbolic (plug and chug) approaches. Your text will most often provide these connections. You need to have a vision for the power of presenting such a balance in order to optimize these aspects of your text. A part of the justification of using all three approaches (besides that it is just good mathematics) is that doing so will reach students with varied learning styles. The majority of our students are not visual/verbal learners, the style to which we traditionally teach. Always present concepts behind your topic, but recognize that some of your students will have to memorize process to be able to pass the course. CPA Approach: Concrete materials should come

Tips for the classroom: • Assign the right amount of "routine" homework with 1 to 2 high level questions • When practicing a skill in class, post high level questions on the chalkboard • Problem of the Week (POW) • Resources: Textbooks, Test Generators, Dept. Meetings, Internet, etc. • Have students explain how to solve POWs and other high level questions Before Quick write Quiz KWL During Daily Assignment Quick Write After Unit Test Exit Problem http://ccsstoolbox.agilemind.com/pdf/Algebra%20I%20Assessments.pdf	Students should be able to use Venn diagrams and mathematical logic to understand and use the addition formula. We will use Venn diagrams to illustrate the idea and then create the formula.  The outcomes in A plus the outcomes in B minus the outcomes in A and B is equal to all of the outcomes in A or B. In terms of probabilities, we can write this as:	first to impress on students that mathematical operations can be used to solve real-world problems. Pictured relationships show visual representations of the concrete manipulatives and help students visualize mathematical operations during problem solving. It is important here that the teacher explain how the pictorial examples relate to the concrete examples. Finally, formal work with symbols is used to demonstrate how symbols provide a shorter and efficient way to represent numerical operations. Ultimately, students need to reach that final level by using symbols proficiently with many of the mathematical skills they master.

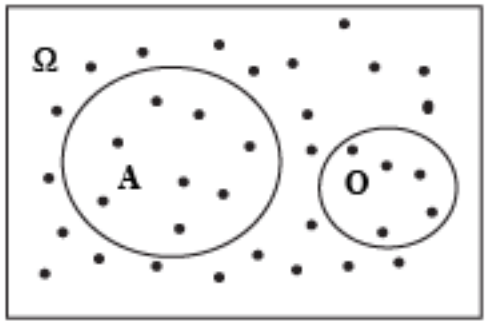
P(A) + P(B) – P(A and B) = P(A or B)

You have a box of fruits and vegetables. The fruits (F) are apples (A) and oranges (O), while the vegetables (V) are carrots (C) and broccoli (B). You already know P(A), P(O), P(V) and P(C), which represent the probabilities of drawing that particular fruit or vegetable from the box. What is the probability of selecting a fruit?

Applying the addition equation, we have

P(A) + P(O) – P(A and O) = P(A or O) = P(F)

Of course, P(A and O) = 0, since a fruit is either an apple or an orange. There are no hybrid Franken-fruit in this box. If we made a Venn diagram in terms of the fruit, we'd see that A and O share no space. The circles don't intersect.



For students, a working knowledge of the addition rule includes recognizing that adding probabilities may result in double-counting outcomes if the two groups that share outcomes. Once students recognize this, they should be able to apply the addition formula, and hopefully even derive it for themselves.

RESOURCES:	VOCABULARY:

AWESOME Common Core High School Math Resource: http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf http://www.shmoop.com http://www.mathforamerica.org/teacher-resources/classroom/lessons http://blog.algebra1teachers.com/ QUALITY Common Core Math Units: http://www.isbe.net/common_core/htmls/math-model-units.htm#hs Full HS Math Curriculum with worksheets and examples: http://boe.townofmanchester.org/departments/CurriculumInstruction/documents/FullMath9-12Curriculum.pdf http://mdk12.org/share/frameworks/CCSC_AlgebraI.pdf www.teach-nology.com/worksheets/math/ Types of Numbers Tutorial: http://www.krysstal.com/numbers.html Complex Numbers Online Book: http://mathforum.org/johnandbetty/ Math Tutorials: http://www.purplemath.com/modules/ http://www.ccsstoolbox.com/	COMBINATIONS, COMPLEMENTS, CONDITIONAL PROBABILITY, COMPLEMENTS, EVENTS, INDEPENDENT EVENTS, INTERSECTIONS, PERMUTATIONS, SAMPLE SPACE, SUBSETS, UNIONS
ESSENTIAL QUESTIONS:	

HOW DOES PROBABILITY HELP TO DEVELOP INFORMED DECISIONS?