Curriculum Management System

MONROE TOWNSHIP SCHOOLS

Course Name: **Dynamics of Algebra 2**
Grade: **11**

For adoption by all regular education programs as specified and for adoption or adaptation by all Special Education Programs in accordance with Board of Education Policy # 2220.

Board Approved: <Type Date Here>

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Monroe Township Schools Administration and Board of Education Members

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Dr. Jeff C. Gorman, Assistant Superintendent

BOARD OF EDUCATION

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WRITERS NAME

Mrs. Jaclyn E. Puleio

CURRICULUM SUPERVISOR

Mrs. Susan Gasko

Mission, Vision, Beliefs, and Goals

Mission Statement

The Monroe Public Schools in collaboration with the members of the community shall ensure that all children receive an exemplary education by well-trained committed staff in a safe and orderly environment.

Vision Statement

The Monroe Township Board of Education commits itself to all children by preparing them to reach their full potential and to function in a global society through a preeminent education.

Beliefs

1. All decisions are made on the premise that children must come first.
2. All district decisions are made to ensure that practices and policies are developed to be inclusive, sensitive and meaningful to our diverse population.
3. We believe there is a sense of urgency about improving rigor and student achievement.
4. All members of our community are responsible for building capacity to reach excellence.
5. We are committed to a process for continuous improvement based on collecting, analyzing, and reflecting on data to guide our decisions.
6. We believe that collaboration maximizes the potential for improved outcomes.
7. We act with integrity, respect, and honesty with recognition that the schools serves as the social core of the community.
8. We believe that resources must be committed to address the population expansion in the community.
9. We believe that there are no disposable students in our community and every child means every child.

Board of Education Goals

1. Raise achievement for all students paying particular attention to disparities between subgroups.
2. Systematically collect, analyze, and evaluate available data to inform all decisions.
3. Improve business efficiencies where possible to reduce overall operating costs.
4. Provide support programs for students across the continuum of academic achievement with an emphasis on those who are in the middle.
5. Provide early interventions for all students who are at risk of not reaching their full potential.
6. To Create a 21st Century Environment of Learning that Promotes Inspiration, Motivation, Exploration, and Innovation.

Common Core State Standards (CSSS)

The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers. With American students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy.

Links:
1. CCSS Home Page: http://www.corestandards.org
2. CCSS FAQ: http://www.corestandards.org/frequently-asked-questions
3. CCSS The Standards: http://www.corestandards.org/the-standards
4. NJDOE Link to CCSS: http://www.state.nj.us/education/sca
5. Partnership for Assessment of Readiness for College and Careers (PARCC): http://parcconline.org

Quarter 1
Unit Topics(s)

I. Relationships
   a. Patterns and expressions
   b. Properties of real numbers
   c. Expressions, equations, and inequalities
   d. Absolute Value equations and inequalities

II. Modeling
   a. Relations and functions
   b. Direct variation
   c. Linear functions
   d. Slope-Intercept form
   e. Linear models
   f. Families of functions
   g. Absolute Value functions and their graphs
   h. Two-variable inequalities

III. Modeling
   a. Solving systems using tables and graphs
   b. Solving systems algebraically
   c. Systems of inequalities
   d. Linear programming
   e. Solving systems using matrices

IV. Non-Linear Relationships
   a. Quadratic functions and transformations
   b. Standard form of a quadratic function
   c. Modeling with quadratic functions
   d. Factoring quadratic expressions
   e. Square roots and radicals
   f. Writing equations from roots
   g. Completing the square
   h. Quadratic formula
   i. Complex numbers
   j. Quadratic inequalities
   k. Quadratic systems

Quarter 2
Unit Topic(s)
V. Functions a. Polynomial functions b. Polynomials, linear factors, and zeros c. Solving polynomial equations d. Dividing polynomials e. Theorems about roots of polynomial equations f. Solving polynomial inequalities g. Fundamental Theorem of Algebra h. Graphing polynomials using zeros i. Binomial Theorem j. Polynomial models in the real world k. Transforming polynomial functions VI. Relationships a. Properties of exponents b. Roots and radical expressions c. Multiplying and dividing radical expressions d. Binomial radical expressions e. Rational exponents f. Solving square root and other radical equations g. Function operations h. Inverse relations and functions i. Graphing radical functions

Quarter 3
Unit Topic(s)

VII. Non-Linear Relationships
- a. Exponential Models
- b. Properties of exponential functions
- c. Logarithmic functions as inverses
- d. Properties of logarithms
- e. Exponential and logarithmic equations
- f. Using logarithms for exponential models
- g. Natural logarithms
- h. Exponential and logarithmic inequalities

VIII. Functions
- a. Inverse variation
- b. Graphing rational functions
- c. Reciprocal function family
- d. Rational functions and their graphs
- e. Oblique asymptotes
- f. Rational expressions
- g. Adding and subtracting rational expressions
- h. Solving rational equations

Quarter 4
Unit Topic(s)

IX. Patterns
- a. Mathematical patterns
- b. Arithmetic sequences
- c. Fibonacci sequence
- d. Geometric sequences
- e. Geometry and infinite series
- f. Geometric series

X. Relationships
- a. Exploring conic sections
- b. Graphing conic sections
- c. Parabolas
- d. Circles
- e. Ellipses
- f. Hyperbolas
- g. Translating conic sections

XI. Risk
- a. Permutations and combinations
- b. Probability
- c. Probability of multiple events
- d. Probability distributions
- e. Conditional probability
- f. Probability models
- g. Analyzing data
- h. Standard deviation
- i. Samples and surveys
- j. Normal distributions
- k. Margin of error
- l. Drawing conclusions from samples

XII. Trigonometry
- a. Exploring periodic data
- b. Special right triangles
- c. Angeles and the unit circle
- d. Measuring radians
- e. Radian measure
- f. The sine function
- g. Graphing trig functions
- h. The cosine function
- i. The tangent function
- j. Translating sine and cosine functions
- k. Reciprocal trig functions
- l. Trig identities

Unit 1 – Relationships (5 blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **A.SSE.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- ✓ **N.RN.3** Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
- ✓ **A.SSE.1.a** Interpret parts of an expression such as terms, factors, and coefficients.
- ✓ **A.CED.1** Create equations and inequalities in one variable and use them to solve problems.
- ✓ **A.CED.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- ✓ **A.SSE.1.b** Interpret complicated expressions by viewing one or more of their parts as a single entity.

Transfer

Students will be able to independently use their learning to…

- Construct, analyze, and identify the relationship among patterns, models, word problems, tables, and graphs through active learning and discovery experiences.

Meaning

UNDERSTANDINGS

Students will understand that…

- The set of real numbers has several special subsets related in particular ways.
- You can represent some mathematical phrases and real-world quantities using algebraic expressions.
- Relations and functions can be represented numerically, graphically, algebraically, and/or verbally.
- The properties of functions and function operations are used to model and analyze real-world applications and quantitative relationships.

ESSENTIAL QUESTIONS

- How do variables help you model real-world situations?
- How can you use the properties of real numbers to simplify algebraic expressions?
- How do you solve an equation or inequality?

Acquisition

Students will know…

Definitions of:

- Variable
- Numerical expression
- Algebraic expression
- Constant
- Terms
- Properties of Equality

Students will be skilled at…

- Using an expression to model the n^{th} term of a pattern
- Using variables to represent unknown quantities in real world situations
- Applying properties of real numbers to simplify algebraic expressions

	• Properties of Inequality • Absolute Value	• Applying the Properties of Equality to solve an equation • Applying the Properties of Inequality to solve an inequality • Finding all values of a variable that make an equation or inequality true • Adding and subtracting rational numbers • Multiplying and dividing rational numbers • Using order of operations • Using an expression to model the n^{th} term of a pattern • Using variables to represent unknown quantities in the real world • Applying the properties of equality to an equation • Applying the properties of Inequality to solve an inequality • Finding all the values of a variable that make an equation or inequality true • Solving an absolute value equation • Solving an absolute value inequality

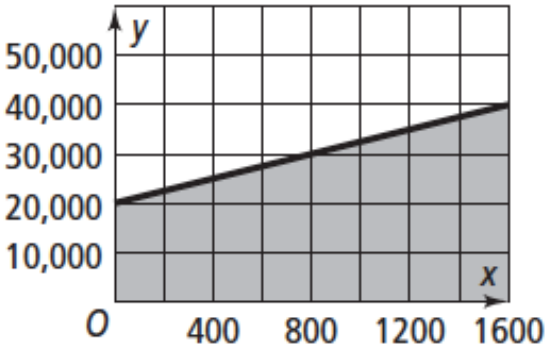
Stage 2 - Evidence

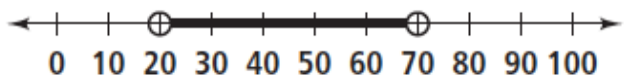
Evaluative Criteria	**Assessment Evidence**
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking.	PERFORMANCE TASK(S): Write a business, scientific (not mathematical), or economic situation for the graphs provided. Include details relating mathematical aspects of the graph to your story.

3 – Applying
Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge.

2 – Developing
Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit.

1 – Beginning
Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.





Prentice Hall: Algebra 2

Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts.

4 – I fully understand my learning and can explain connections. I am able to explain it to someone else.

3 – I understand my learning and can make some connections, but can use some help.

2 – I understand parts of my learning and need help making connections.

1 – I do not understand my learning and cannot make connections, please help.

OTHER EVIDENCE:

Open-Ended (Formative) Assessment:

- ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)*
- ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics.
- ✓ Homework Quick Checks (provided by textbook)
- ✓ Lesson Checks (provided by textbook)

Summative Assessment: Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section.

- ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons.
- ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Exploration: Using an expression to model the n^{th} term of a pattern; using variables to represent unknown quantities in real world situations
Activity: Applying properties of real numbers to simplify algebraic expression; applying the Properties of Equality to solve an equation; applying the Properties of Inequality to solve an inequality; finding all values of a variable that make an equation or inequality true
Activity: Adding and subtracting rational numbers; multiplying and dividing rational numbers; using order of operations
Activity: Solving an absolute value equation; solving an absolute value inequality

Utilize resources from Chapter 1 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

www.PowerAlgebra.com

www.ShowMe.com

www.EduCreations.com

www.KhanAcademy.com

http://mathbits.com/MathBits/MathMovies/ResourceList.htm

Unit 2 – Modeling (7 Blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **F.IF.1** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).
- ✓ **F.IF.2** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- ✓ **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ✓ **F.BF.1** Write a function that describes a relationship between two quantities.
- ✓ **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.

Transfer

Students will be able to independently use their learning to…

- Utilize real life data to make predictions about a tourist business's income.

Meaning

UNDERSTANDINGS

Students will understand that…

- Different mathematical models can express the relationship of a data set.
- The features of an equation directly affect the appearance of a graph.
- The slopes of two lines in the same plane impact their relationship.
- There are a variety of methods to represent functions that may present the benefit of their utility depending on the nature of the need.

ESSENTIAL QUESTIONS

- Does it matter which form of a linear equation you use?
- How do the characteristics of a function's equation affect the appearance of a graph?
- How can a mathematical model be used to represent or approximate the relationship of a data set?

Acquisition

Students will know…

Definitions of:

- Domain
- Rate of Change
- Reflection
- Boundary
- Correlation Coefficient
- Linear equations can model real life scenarios to approximate and draw conclusions.
- Scatterplots show the relationship of two quantitative data sets.

Students will be skilled at…

- Simplifying expressions
- Solving equations
- Solving absolute value inequalities
- Graphing absolute value equations
- Identifying, describing, and applying transformations to the parent graph

✓ **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. ✓ **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. ✓ **F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ✓ **F.IF.7.b** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ✓ **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. ✓ **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.		

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	PERFORMANCE TASK(S): Weather can greatly affect the economy of an area. Ski resorts lose much money during mild winters. The businesses along sunny beaches also lose money when hurricanes drive everyone away. Choose one area that you would like to research. Collect data including the temperature and the local entrepreneurial income. Present your data in a table, create a scatterplot, and determine whether a linear model is appropriate. Attempt to create a line of best fit and make a prediction. Document your sources. Identify the place you are researching. Summarize your findings in a paragraph, provide your data in a table, and display your scatterplot.
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)*

4 – I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Simplifying expressions
Activity: Solving equations
Activity: Solving absolute value inequalities
Activity: Graphing absolute value equations
Exploration: Identifying, describing, and applying transformations to the parent graph

Utilize resources from Chapter 2 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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Unit 3 - Modeling (6 Blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ✓ **A.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- ✓ **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.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.5** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- ✓ **A.REI.12** Graph the solutions to a linear

Transfer

Students will be able to independently use their learning to…

- Model multiple real life scenarios and analyze outcomes to make effective business decisions.

Meaning

UNDERSTANDINGS

Students will understand that…

- A solution of a system of linear equations models a unique outcome for two or more real-life situations.
- Systems of linear equations model real life situations to make predictions given certain conditions.
- Systems of linear inequalities model all possible outcomes for two or more real-life situations.

ESSENTIAL QUESTIONS

- How does representing a function graphically help you to solve a system of equations?
- How does writing equivalent equations help you solve a system of equations?
- What are some strategies useful in determining which method is best to use when solving systems of equations?
- How is the solution of a system of linear inequalities similar and different to the solution of a system of linear equations?

Acquisition

Students will know…

- A solution of a system of linear equations in two variables is an ordered pair, (x, y), that satisfies each equation in the system.
- A solution of a linear system is the intersection point of the two or more lines.
- Linear combination of two equations is an equation obtained by adding one of

Students will be skilled at…

- Solving a system of two or more equations
- Solving a system of linear equations by graphing on a coordinate plane
- Solving a system of linear equations by graphing on a graphing calculator
- Checking the intersection point to verify it is a solution of the system
- Modeling a real-life problem using a

inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. ✓ **A.REI.8** Represent a system of linear equations as a single matrix equation in a vector variable.	the equations (or a multiple of one of the equations) to the other equation. • Graphing is a useful method for approximating a solution, checking the reasonableness of a solution, and providing a visual model. • To avoid fractional or decimal coefficients, multiply the equation by a constant first before solving. • A solution to a system of linear equations is the intersection of the two lines and is a consistent independent system. • A solution to a system of linear equations that are parallel, has no intersection, thus has no solution is an inconsistent system. • A solution to a system of linear equations that turns out to be the same line, has infinite intersections, thus has infinitely many solutions and is a consistent dependent system. • Two or more linear inequalities form a system of linear inequalities. • A solution of a system of linear inequalities is an ordered pair that is a solution of each inequality in the system. • The graph of a system of linear inequalities is the graph of all solutions that satisfy the system. • A solid line is used when the inequality is composed of the symbols: $\leq$ *or* $\geq$. • A dotted line is used when the inequality is composed of the symbols: $<$ *or* $>$.	linear system. • Using substitution to solve a linear system • Using linear combinations to solve a system of linear equations • Choosing the best method to solve a system of linear equations • Identifying linear systems as having one solution, no solution, or infinitely many solutions • Solving a system of linear inequalities by graphing using a coordinate plane • Solving a system of linear inequalities by graphing using a graphing calculator • Using a system of linear inequalities to model a real-life situation

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	PERFORMANCE TASK(S): **CELL PHONE PLAN** Your cell phone plan has just expired with Sprint and you want to switch companies. You know you want to either choose between Verizon and AT&T, but your parents don't want to hear it! They keep saying something like Sprint is the best deal out there. Are they right? Below is the information you gathered regarding the plans you are considering: SPRINT has an initial monthly charge of $25 for providing their services and charges $0.30 for every minute. VERIZON charges $55 per month and $0.10 for every minute. AT&T does not have an initial monthly charge. It charges $0.70 for every minute. Note: No more free nights and weekends included in plans! You decided to look deeply into this before making a decision and presenting the argument to your parents to make sure they will take you seriously. Your job is going to be to prepare an argument with your group that aids your argument for changing cell phone plans. Your group will present your argument to your parents to get them to change their minds. Every group's argument will be different based on how many minutes you usually use per month. *You are to create the following:* Decide on an average minute usage among your group members. Equations that represent each of your options. Each equation should be clearly labeled with its corresponding plan. A graph that represents the information on the plans that you have put together. You should use different colors to represent the different plans. Identify the colors with its corresponding plan using a key. Write a letter to convince your parents to change your cell phone plan utilizing evidence

	demonstrated from your graphs and calculations.
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Exploration: Solving a system of two or more equations; solving a system of linear equations by graphing on a coordinate plane; solving a system of linear equations by graphing on a graphing calculator; checking the intersection point to verify it is a solution of the system; modeling a real-life problem using a linear system
Activity: Using substitution to solve a linear system; using linear combinations to solve a system of linear equations; choosing the best method to solve a system of linear equations
Exploration: Identifying linear systems as having one solution, no solution, or infinitely many solutions
Activity: Solving a system of linear inequalities by graphing using a coordinate plane; solving a system of linear inequalities by graphing using a graphing calculator; using a system of linear inequalities to model a real-life situation

Utilize resources from Chapter 3 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

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http://mathbits.com/MathBits/MathMovies/ResourceList.htm

Unit 4 – Non-linear Relationships (8 Blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ✓ **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.
- ✓ **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.
- ✓ **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.
- ✓ **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

Transfer

Students will be able to independently use their learning to…

- Project the path of any object using the laws of vertical motion in physics.

Meaning

UNDERSTANDINGS

Students will understand that…

- A quadratic equation can be represented in multiple ways.
- Characteristics of different quadratic representations can be more useful than others in situations.
- Features of a graph help to determine the number of real and complex solutions each quadratic equation has.
- The number of solutions in a system of equations is directly related to the families to which the equations belong.

ESSENTIAL QUESTIONS

- How can you utilize the features of a quadratic equation to determine the shape of its graph?
- How do you know which method to use in order to solve a quadratic equation?
- How can you utilize quadratics in real life situations?
- How can you utilize a system of a quadratic and linear graph in a real life situation?

Acquisition

Students will know…

- The graph of any quadratic function is a transformation of the graph of the parent quadratic function, $y=x^2$.
- For any quadratic function $f(x)=ax^2+bx+c$, the values of a, b, and c provide key information about its graph.
- Three no-collinear points, no two of which are in line vertically, are on the graph of exactly one quadratic function.
- You can solve systems involving quadratic equations using methods

Students will be skilled at…

- Graphing a function of the form $f(x)=ax^2$
- Graphing translations of $f(x)=x^2$
- Interpreting vertex form
- Using vertex form
- Writing a quadratic function in vertex form
- Finding the features of a quadratic function
- Graphing a function in standard form
- Converting standard form to vertex form

✓ **F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ✓ **F.BF.1** Write a function that describes a relationship between two quantities. ✓ **F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ✓ **A.SSE.2** Use the structure of an expression to identify ways to rewrite it. ✓ **N.RN.2** Rewrite expressions using radical and rational exponents using the properties of exponents. ✓ **A.SSE.1.a** Interpret parts of an expression such as terms, factors, and coefficients. ✓ A.APR.3 ✓ **A.CED.1** Create equations and inequalities in one variable and use them to solve problems. ✓ **A.REI.4.b** Solve quadratic equations in one variable. ✓ **N.CN.1** Know there is a complex number I such that $I^2 = -1$, and every complex number as the form a + bi with a and b real. ✓ **N.CN.2** Use the relation $I^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. ✓ **N.CN.7** Solve quadratic equations with real coefficients that have complex	similar to the ones used to solve system of linear equations. • To find the zeros of a quadratic function $f(x)=ax^2+bx+c$, solve the related quadratic equation, $ax^2+bx+c=0$. • Many quadratic trinomials ax^2+bx+c can be factored into products of two binomials • Completing a perfect square trinomial factors the completed trinomial into the square of a binomial. • A quadratic equation $ax^2+bx+c=0$ can be solved in more than one way. In general, a formula can be found that gives values of x in terms of a, b, and c. • A basis for the complex numbers is a number whose square root is -1. Every quadratic equation has complex number solutions that are sometimes real numbers.	• Interpreting a quadratic graph in standard form • Writing an equation of a parabola • Using a quadratic model to make predictions • Using a quadratic regression • Solve a quadratic by factoring • Solving a quadratic equation with tables • Solving a quadratic equation by graphing and/or using a graphing utility • Solve by finding the square root • Solving a perfect square trinomial • Completing the square • Solving by completing the square • Writing a quadratic equation in vertex form • Simplifying a number using *i* • Graphing in the Complex Number Plane • Operations with complex numbers (add/subtract/multiply/divide) • Finding imaginary solutions • Solving a Linear-Quadratic system by graphing or substitution • Solving a quadratic system of inequalities

solutions. ✓ **N.CN.8** Extend polynomial identities to the complex numbers. ✓ **A.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. ✓ **A.REI.7** 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 $x^2 + y^2 = 3$.		

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing**	PERFORMANCE TASK(S): During a football game, a team has four plays, or downs to advance the football ten yards. After a first down is gained, the team has another four downs to gain ten or more yards. If a team does not move the football ten yards or more after three downs, then the team has the option of punting the football. By punting the football, the offensive team gives possession of the ball to the other team. Punting is the logical choice when the offensive team (1) is a long way from making a first down, (2) is out of field goal range, and (3) is not in a critical situation. To punt the football, a punter receives the football about 10 to 12 yards behind the person who is playing center. The punter's job is to kick the football as far down the field as possible without the ball going into the end zone. **In Exercises 1–4, use the following information.** A punter kicked a punt. The path of the football can be modeled by $y = -\frac{1}{4}(x-4)(x-40)$, where x is the distance (in yards) the football is kicked and y is the height (in yards) the football is kicked.

Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	**1.** Describe the path of a football that is kicked. You may **support** your description with a picture. **2.** Does the graph have a *maximum value* or a *minimum value*? Explain how you know using the equation. (Do not solve for it here, just explain.) **3.** If the punter is standing on the 40 yard line, according to the equation, where did his punt land? Was this a good punt? **4.** Find the maximum height of the football. **5.** Graph the quadratic function. Be sure to label your axes. **6.** Convert the equation $y = -\frac{1}{4}(x-4)(x-40)$ **into standard form**. **7.** Using your equation from the answer to #6, convert **into vertex form**. **In Exercises 8–10, use the following information.** On fourth down, a team is in field goal range. The field goal kicker is called in to kick a field goal. This kick can be modeled by where *x* is the distance (in yards) the football is kicked and *y* is the height (in yards) the football is kicked. **8.** If the field goal kicker is standing on the 30 yard line and the field goal post is at the 0 yard line and 20 feet high, write the equation of the kick in **vertex form.** Assume the highest point of the kick goes at the field goal post. **9.** Graph the quadratic function by connecting the point where the kicker is standing and the point the ball reaches when it hits its highest point. **10.** To kick the ball into the end zone through the field goal, the kicker needs to kick the football through the field goal post. Describe the path of your field goal kicker's kick. Did the field goal kicker make the goal? Explain using your graph and your equation.
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice

key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment
Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan
Activity: Graphing a function of the form $f(x)=ax^2$**.** Graphing translations of $f(x)=x^2$.

Exploration: Interpreting Vertex Form**;** using Vertex Form**;** writing a quadratic function in Vertex Form**; f**inding the features of a quadratic function
Activity: Graphing a function in standard form; converting standard form to vertex form; interpreting a quadratic graph in standard form; writing an equation of a parabola
Exploration: Using a quadratic model to make predictions; using a quadratic regression
Activity: Solving a quadratic by factoring; solving a quadratic equation with tables; solving a quadratic equation by graphing and/or using a graphing utility; solving by finding the square root; solving a perfect square trinomial; completing the square; solving by completing the square
Activity: Writing a quadratic equation in vertex form
Activity: Simplifying a number using $\boldsymbol{i}$; graphing in the Complex Number Plane; performing operations with complex numbers (add/subtract/multiply/divide); finding imaginary solutions
Activity: Solving a Linear-Quadratic system by graphing or substitution; solving a quadratic system of inequalities

Utilize resources from Chapter 4 including:
- Think About a Plan

- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

www.PowerAlgebra.com

www.ShowMe.com

www.EduCreations.com

www.KhanAcademy.com

http://mathbits.com/MathBits/MathMovies/ResourceList.htm

Unit 5 – Functions (8 Blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **A.SSE.1.a** Interpret parts of an expression such as terms, factors, and coefficients.
- ✓ **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.
- ✓ **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.
- ✓ **F.IF.7.c** Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- ✓ **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.
- ✓ **F.BF.1** Write a function that describes a

Transfer

Students will be able to independently use their learning to…

- Identify key features of a graph with multiple roots to make predictions.

Meaning

UNDERSTANDINGS

Students will understand that…

- The leading coefficient and degree of a polynomial determine the general shape of a graph for any family of functions.
- The factors of a polynomial direct affect its graph.
- The degree of a polynomial is related to the number of roots in the polynomial.

ESSENTIAL QUESTIONS

- How might a polynomial that models a real life situation be used to make predictions?
- How does the degree of a polynomial distinguish key features in comparison to its related polynomial function?
- How are the factors, zeros, and x-intercepts related for any polynomial?
- How are factors and roots related?

Acquisition

Students will know…

Definitions of:

- Conjugate Root Theorem
- Constant of proportionality
- Degree of a polynomial
- Sum/Difference of Cubes
- End Behavior
- Fundamental Theorem of Algebra
- Multiplicity
- Polynomial function
- Rational Root Theorem
- Relative maximum/minimum
- Remainder Theorem
- Standard form

Students will be skilled at…

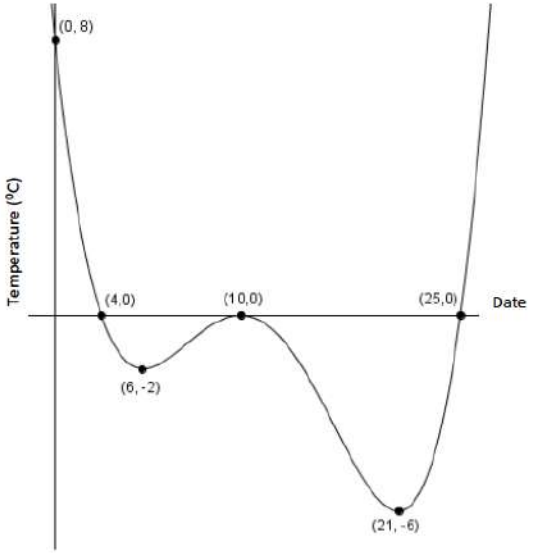
- Classifying polynomials
- Describing end behavior of polynomial functions
- Graphing cubic functions
- Using differences to determine the degree
- Writing a polynomial in factored form
- Finding zeros of a polynomial function
- Writing a polynomial function from its zeros
- Finding the multiplicity of a zero
- Identifying relative maximums and minimums
- Using a polynomial in real life situations
- Solving polynomial equations using factors
- Solving polynomial equations by factoring (grouping, sum or difference of cubes, difference

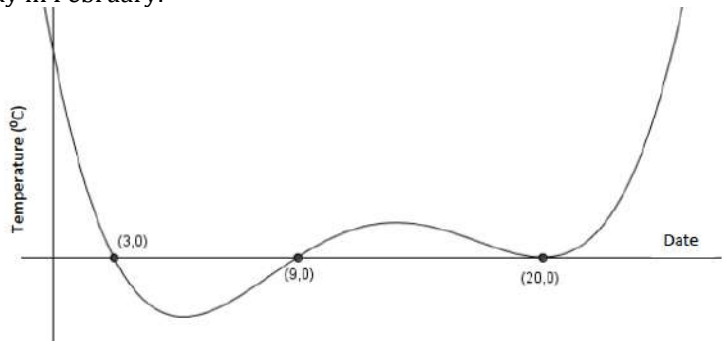
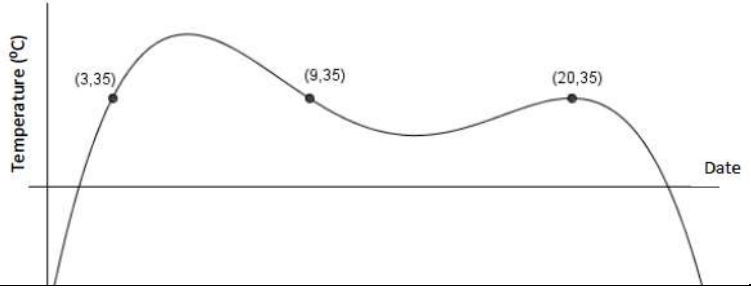
relationship between two quantities. ✓ **A.SSE.2** Use the structure of an expression to identify ways to rewrite it. ✓ **A.REI.11** Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions 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.APR.1** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. ✓ **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). ✓ **A.APR.6** 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. ✓ **N.CN.7** Solve quadratic equations with	• Synthetic Division • Turning point	of squares, perfect square polynomial, quadratic trinomial, factoring out the greatest common factor) • Finding real roots by graphing • Using polynomial long division • Checking factors • Using synthetic division • Evaluating a polynomial using synthetic division • Finding a rational root • Using the Rational Root Theorem • Using Conjugate Root Theorem to identify roots • Using conjugates to construct a polynomial • Using the Fundamental Theorem of Algebra • Finding all the zeros of a polynomial function • Transforming $y=x^3$ • Finding zeroes of a transformed cubic function • Constructing a quartic function with two real zeros • Modeling with a power function

real coefficients that have complex solutions. ✓ **N.CN.8** Extend polynomial identities to the complex numbers. ✓ **A.APR.4** Prove polynomial identities and use them to describe numerical relationships. ✓ **N.CN.9** Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. ✓ **A.APR.5** Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle. ✓ **F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ✓ **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. ✓ **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. ✓ **F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ✓ **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.		

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning**	PERFORMANCE TASK(S): **Heat Wave** The town of Frostburg experienced a bit of a heat wave during January of this year. The graph below shows the curve of best fit that represents the low temperature for every day in January. A newspaper journalist is writing a story on the weather and needs to report some information. He needs a bit of guidance with interpreting the graph. 

Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	1) Write a few sentences describing the key characteristics of the graph as it relates to the context of the problem. Be sure to include domain, range, intervals where the function increases and decreases, x- and y intercepts, and any other important information. The graph below shows the curve of best fit that represents the low temperature for every day in February.  2) Three different models have been proposed that could be used to determine the temperature for a particular date in February. The models are given below: Model 1: $y = ax^2 + bx + c$ Model 2: $y = a(x+3)(x+9)(x+20)$ Model 3: $y = \frac{a}{(x+3)(x+9)^2(x+20)}$ None of these models are completely appropriate for the graph. Explain what is incorrect with each of the models and then suggest and justify a better model. The weather in July showed a related pattern to the weather in February. The curve of best fit for July is shown below: 

	3) Explain the relationship between the graph for February and the graph for July. Use that relationship to create an equation for the temperatures in July. www.doe.virginia.gov/instruction/.../9.../algebra2_task_heatwave.pdf
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment
Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Classifying polynomials
Exploration: Describing end behavior of polynomial functions; using differences to determine the degree
Activity: Graphing cubic functions
Activity: Writing a polynomial in factored form; finding zeros of a polynomial function; writing a polynomial function from its zeros; finding the multiplicity of a zero; identifying relative maximums and minimums
Activity: Using a polynomial in real life situations; solving polynomial equations using factors; solving polynomial equations by factoring (grouping, sum or

difference of cubes, difference of squares, perfect square polynomial, quadratic trinomial, factoring out the greatest common factor)
Exploration: Finding real roots by graphing; using polynomial long division; checking factors
Activity: Using Synthetic Division; evaluating a polynomial using synthetic division; finding a rational root; using the Rational Root Theorem; using Conjugate Root Theorem to identify roots; using conjugates to construct a polynomial; using the Fundamental Theorem of Algebra; finding all the zeros of a polynomial function
Activity: Transforming $y=x^3$; finding zeroes of a transformed cubic function; constructing a quartic function with two real zeros
Exploration: Modeling with a power function

Utilize resources from Chapter 5 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

www.PowerAlgebra.com

www.ShowMe.com

www.EduCreations.com

www.KhanAcademy.com

http://mathbits.com/MathBits/MathMovies/ResourceList.htm

Unit 6 - Relationships
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **N.RN.1** 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.
- ✓ **A.SSE.2** Use the structure of an expression to identify ways to rewrite it.
- ✓ **N.RN.2** Rewrite expressions using radical and rational exponents using the properties of exponents.
- ✓ **A.CED.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- ✓ **A.REI.2** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- ✓ **F.BF.1** Write a function that describes a relationship between two quantities.
- ✓ **F.BF.1.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.
- ✓ **F.BF.4.a** Find inverse functions.
- ✓ **F.BF.4.c** Read values of an inverse

Transfer

Students will be able to independently use their learning to…

- Construct viable arguments and using the appropriate tools to critique the structure and reasoning abstractly and quantitatively while attending to precision.

Meaning

UNDERSTANDINGS

Students will understand that…

- Corresponding to every power, there is a root.
- You can combine like radicals using properties of real numbers.
- A radical expression can be represented in multiple ways.
- Not all answers to an equation are solutions.
- The domain of a function determines the characteristics of its graph.
- A square root function and a quadratic function are inversely related.

ESSENTIAL QUESTIONS

- What has to be true in order for an expression to be simplified by the n^{th} root?
- How does squaring both sides of an equation affect it?
- How are a function and its inverse related?

Acquisition

Students will know…

Definition of:

- Composite function
- Index
- Inverse function
- Inverse relation
- Like radicals
- N_{th} root

Students will be skilled at…

- Finding all real roots
- Finding all roots
- Simplifying radical expressions
- Using a radical expression in a real life scenario.
- Multiplying radical expressions
- Simplifying radical expression

function from a graph or a table, given that the function has an inverse. ✓ **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. ✓ **F.IF.7.b** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ✓ **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	• One-to-one function • Principal root • Radical equation • Radical function • Radicand • Rational Exponent • Rationalizing the denominator • Simplest form of a radical • Square root equation • Square root function • Corresponding to every power, there is a root. • If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, then $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$ • You can combine radicals using properties of real numbers. • You can write a radical expression in an equivalent form using a fractional (rational) exponent instead of a radical sign. • Solving a square root equation may require that you square each side of the equation which can introduce extraneous solutions. • You can add, subtract, multiply and divide functions. • You must consider the domain for each function. • The inverse of a function may or may not be a function. • A square root function is the inverse of a quadratic function with a restricted domain.	• Simplifying a product • Dividing radical expressions • Rationalizing the denominator • Adding/subtracting radical expressions • Simplifying radicals and combining like terms • Multiplying binomial radical expressions • Multiplying conjugates • Simplifying expressions with rational exponents • Converting between exponential and radical form • Combining radical expressions • Simplifying numbers with rational exponents • Writing expressions in simplest form • Solving a square root equation • Solving other radical equations • Checking for extraneous solutions • Solving an equation with two radicals • Adding, subtracting, multiplying, dividing functions • Composing functions • Finding the inverse of a relation • Finding an equation for the inverse • Graphing a relation and its inverse • Finding an inverse function • Finding the inverse of a formula • Composing inverse functions • Translating a square root function • Graphing a square root function • Solving a radical equation by graphing • Graphing a cube root function • Rewriting a radical function

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	PERFORMANCE TASK(S): ***Activity 1: Constructing*** Have students construct a simple pendulum by tying a medium binder clip to the end of a piece of string. The binder clip will be used to hold coins for the experiments. The weight on the end of the string is called the "pendulum bob". The period of a pendulum is the time it takes for the pendulum to complete one full swing (back and forth). ***Activity 2: Investigating*** *Experiment 1* Tie the free end of the string of the pendulum to a stable object. Do this in such a way that neither the string nor the bob touch another object when the pendulum is swung. Insert one coin in the binder clip. Measure the length of the string (in centimeters) from the point where it is attached to the stable object to the center of the bob. Record this length. Three times, pull the pendulum back to an angle of about 20° and let it go. For each trial, use a stopwatch to record the number of seconds it takes for the pendulum to complete 10 full swings. Record each time in the first column of the table provided on the next page. Next, find and record the average of the three times you listed. Finally, divide the average time by 10 to determine the period of the pendulum. Repeat the procedure using two coins, then using three coins, record the data in the second and third columns, respectively. Does it appear that the weight of the bob affected the period of the pendulum? What factors other than the weight might affect the period of the pendulum? | | 1 coin | 2 coins | 3 coins | | Trial 1 | | | | | Trial 2 | | | | | Trial 3 | | | | | Average time to complete 10 full swings | | | | | Period of pendulum | | | | *Experiment 2* Cut a second string that is half the length of the original string. Repeat Experiment 1. Record data in a table. Does it appear that the pendulum string length affects its period? Explain. *Activity 3: Analyzing*

	The formula $l = \frac{980t^2}{4\pi^2}$ represents the length l (in centimeters) of a simple pendulum with a period of t seconds. (In this formula, the acceleration due to gravity is given as 980 cm/s^2.) • Solve for t. According to the formula, how does changing the weight of the bob affect the period of a pendulum? • Use the formula to find the theoretical period for each pendulum. Record your experimental and theoretical periods for each. Do your experimental results give the same period as the theoretical models? What factors do you think would account for any differences? Explain your observations. Prepare a presentation for the class describing your results. Your presentation should include a chart showing your experimental and theoretical results. Reflect and Revise When you are sure your data are accurate, decide if your presentation is complete, clear, and convincing. If needed, make changes to improve your presentation. ***SOURCES: Basic Physics: A Self-Teaching Guide, Second edition, p. 104, by Karl F. Kahn, 1996, John Wiley & Sons, Inc.;*** ***Physics, p. 242, by John D. Cutnell and Kenneth W. Johnson, 1989, John Wiley & Sons, Inc.*** *Prentice Hall Algebra 2 • Teaching Resources*
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook)

	Length of Pendulum	Experimental Period	Theoretical Period
Experiment 1			
Experiment 2			

someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Exploration: Finding all real roots; finding all roots; simplifying radical expressions; using a radical expression in a real life scenario
Activity: Multiplying radical expressions; simplifying radical expression; simplifying a product; dividing radical expressions; rationalizing the denominator; adding/subtracting radical expressions
Activity: Simplifying radicals and combining like terms; multiplying binomial radical expressions; multiplying conjugates; simplifying expressions with rational exponents; converting between exponential and radical form; combining radical expressions; simplifying numbers with rational exponents; writing expressions in simplest form
Exploration Activity: Solving a square root equation; solving other radical equations; checking for extraneous solutions; solving an equation with two radicals
Activity: Adding, subtracting, multiplying, dividing functions; composing functions
Exploration: Finding the inverse of a relation; finding an equation for the inverse; graphing a relation and its inverse; finding an inverse function; finding the inverse of a formula; composing inverse functions
Activity: Translating a square root function; graphing a square root function; solving a radical equation by graphing; graphing a cube root function

Utilize resources from Chapter 6 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks

- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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http://mathbits.com/MathBits/MathMovies/ResourceList.htm

Unit 7 - Relationships
Stage 1 Desired Results

a ESTABLISHED GOALS

- ✓ **A.SSE.1.b** Interpret complicated expressions by viewing one or more of their parts as a single entity.
- ✓ **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ✓ **F.IF.7.e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- ✓ **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.
- ✓ **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- ✓ **F.BF.1** Write a function that describes a relationship between two quantities.
- ✓ **F.BF.1.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.

Transfer

Students will be able to independently use their learning to…

- Use appropriate tools strategically to model real life situations that express regularity in repeated reasoning with mathematical expressions.

Meaning

UNDERSTANDINGS

Students will understand that…

- Logarithms and exponents have corresponding properties.
- Logarithms and exponents are inversely related.

ESSENTIAL QUESTIONS

- How do you model the relationship of a quantity that changes over time?
- How are exponents and logarithms related?
- How are exponential functions and logarithmic functions related?

Acquisition

Students will know…

Definition of:

- Asymptote
- Change of Base Formula
- Common log
- Exponential equation
- Exponential function
- Exponential growth
- Exponential decay
- Logarithm
- Logarithmic equation
- Logarithmic function
- Natural log function

- Repeated multiplication can be

Students will be skilled at…

- Modeling situations with exponential functions
- Using exponents to solve logarithmic equations and logarithms to solve exponential equations
- Showing that exponents and logarithms are inverse functions
- Graphing exponential and logarithmic functions

✓ **F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ✓ **F.BF.4.a** Find inverse functions. ✓ **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. ✓ **F.LE.4** 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. ✓ **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.	represented with a function in the form of $y = ab^x$ where b is a positive number other than one. • The exponential function of $y = b^x$ is one-to-one, so its inverse $x = b^y$ is a function. We represent this relationship as $y = \log_b x$. • The functions $y = e^x$ and $y = \ln x$ are inverse functions. • The factor a in $y = ab^x$ can stretch or compress and possibly reflect the graph.	

✓ **F.LE.4** 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. ✓ **F.IF.7.e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. ✓ **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.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.		

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying**	PERFORMANCE TASK(S): You are an environmental scientist hired by the United States government to advise them as they take steps to lead in a worldwide effort to face a global environmental crisis. You will focus your research on the population growth rate and investigate the effect on a related item such as waste, food, disease, life expectancy/mortality rate, poverty, inflation or national debt. Identify an issue related to the global situation, which exhibits characteristics of change that can be modeled by an exponential function. Prepare a presentation that includes multiple representations of the data and well-justified predictions using this data. Show a video clip from "An Inconvenient Truth" or show one of the video clips available from www.climateclassroom.org or http://www.nwf.org/wildlifeandglobalwarming/globalwarmingandwildlife.cfm.

Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	*Reger, Cheryl. Secondary PBL Project, 2008-2009. http://wveis.k12.wv.us/teach21/public/project/Guide.cfm?upid=3328&tsele1=2&tsele2=116*
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.
Stage 3 – Learning Plan	
Summary of Key Learning Events and Instruction	

Pre-Assessment
Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Modeling situations with exponential functions
Activity: Using exponents to solve logarithmic equations and logarithms to solve exponential equations
Exploration: Showing that exponents and logarithms are inverse functions
Activity: Graphing exponential and logarithmic functions

Utilize resources from Chapter 7 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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Unit 8 – Relationships (7 blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- ✓ **A.CED.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- ✓ **A.CED.1** Create equations and inequalities in one variable and use them to solve problems.
- ✓ **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.
- ✓ **F.IF.7.d** Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
- ✓ **F.BF.1** Write a function that describes a relationship between two quantities.
- ✓ **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

Transfer

Students will be able to independently use their learning to…

- Construct, analyze, and identify key components of a function and its graph.

Meaning

UNDERSTANDINGS

Students will understand that…

- The characteristics of variation functions and their representations are useful in solve real-world problems.
- A graph is a directly affected by the restrictions of its domain and range.
- The components of a function's equation directly affect its graphical representation.

ESSENTIAL QUESTIONS

- Are two quantities inversely proportional if an increase in one corresponds to a decrease in the other?
- How are asymptotes used to define the structure of rational functions?
- Are a rational expression and its simplified form equivalent?
- How do variation functions model real-world problems and their solutions?

Acquisition

Students will know…

Definition of:

- Combined variation
- Complex fraction
- Continuous graph
- Discontinuous graph
- Inverse variation
- Joint variation
- Point of discontinuity
- Rational equation
- Rational expression
- Rational function
- Reciprocal function

Students will be skilled at…

- Identifying direct and inverse variations
- Determining an inverse variation
- Using combined variation
- Modeling with inverse variation and/or combined variation
- Graphing inverse variation
- Identifying a reciprocal function transformation
- Graphing a translation
- Writing an equation for a transformation
- Finding points of discontinuity
- Finding and graphing asymptotes of

and odd functions from their graphs and algebraic expressions for them. ✓ **F.BF.1.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. ✓ **A.SSE.1** Interpret expressions that represent a quantity in terms of its context. ✓ **A.SSE.1.a** Interpret parts of an expression such as terms, factors, and coefficients. ✓ **A.SSE.1.b** Interpret complicated expressions by viewing one or more of their parts as a single entity. ✓ **A.SSE.2** Use the structure of an expression to identify ways to rewrite it. ✓ **A.APR.7** Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. ✓ **A.APR.6** 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	• If a product is constant, a decrease in the value of one factor must accompany an increase in the value of the other factor. • In a direct variation, two positive quantities either increase together or decrease together. • In an inverse variation, as a quantity increases, the other decreases. • Quantities x and y are inversely proportional if increase c by a factors of k where k does not equal zero means shrinking y by the factor $\frac{1}{k}$	rational functions • Identifying whether a rational function will have an asymptote • Differentiating between vertical, horizontal, and oblique asymptotes • Performing operations with rational expressions • Defining the domains of simplified rational expressions to make them equivalent to the originals

algebra system. ✓ **A.REI.2** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. ✓ **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.		

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge.	PERFORMANCE TASK(S): **Exploration** a. Write a function that models an inverse variation situation. b. Find the constant of the inverse variation. c. Determine the dependent and independent variables. d. Identify the domain and range. e. Find the values of any asymptotes. f. Graph the function, making sure to indicate any asymptotes. ***Prentice Hall: Algebra 2***

2 – Developing Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Determining an inverse variation; using combined variation; graphing inverse variation; identifying a reciprocal function transformation; graphing a translation; writing an equation for a transformation
Exploration: Finding points of discontinuity; finding and graphing asymptotes of rational functions; identifying whether a rational function will have an asymptote
Activity: Differentiating between vertical, horizontal, and oblique asymptotes
Activity: Performing operations with rational expressions; defining the domains of simplified rational expressions to make them equivalent to the originals

Utilize resources from Chapter 8 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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Unit 9 – Patterns (4 blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **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.
- ✓ **F.IF.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

Transfer

Students will be able to independently use their learning to…

- Analyze a string of numbers to construct and model patterns with mathematics by reasoning abstractly and quantitatively.

Meaning

UNDERSTANDINGS

Students will understand that…

- Mathematical models are used to model and describe patterns.
- If the numbers in a list follow a pattern, a model can relate each number in the list to its numerical position in the list with a rule.
- If the numbers in a list follow a pattern, each number in the list can be related to its numerical position in the list with more than one equivalent rules.
- Sequences and series can model many mathematical relationships and realistic situations.

ESSENTIAL QUESTIONS

- How can you represent the terms of a sequence using a mathematical expression?
- How are sequences and series used to model many mathematical ideas and realistic situations?
- How do we use sequence notation to write the terms of a sequence?
- How do we use factorial notation?
- How do we use summation notation to write sums?

Acquisition

Students will know…

Definition of:

- Arithmetic sequence
- Arithmetic series
- Common difference
- Common ratio
- Converge

Students will be skilled at…

- Identifying mathematical patterns found in a sequence
- Generating a sequence using an explicit formula
- Writing a recursive definition for a sequence

	• Diverge • Explicit formula • Geometric sequence • Geometric series • Limits • Recursive formula • If the numbers in a list follow a pattern, variables may be used to relate each number in the list to its numerical position in the list, • In an arithmetic sequence the difference between any two consecutive terms is always the same number. • When two terms followed by a number of terms in a finite arithmetic sequence are known, they can be substituted for variables in a formula to find the sum of the terms. • In an arithmetic sequence, the difference between any two consecutive terms is always the same number. An arithmetic sequence can be built by adding the same number to each term. When two terms followed by a number of terms in a finite arithmetic sequence are known, one of equivalent formulas can be used to find the sum of the terms. • In a geometric sequence, the ratio of any term (after the first) to its preceding term is a constant value. A geometric sequence is built by multiplying the terms by that constant.	• Writing an explicit formula for a sequence • Using formulas to find terms of a sequence • Identifying arithmetic sequences • Using the arithmetic mean • Using an explicit formula for an arithmetic sequence • Finding the sum of a series • Finding the common difference of an arithmetic sequence • Finding the common ratio of a geometric sequence • Determining whether a geometric series converges

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	PERFORMANCE TASK(S): **Building a Pyramid** Build a model of a square pyramid using sugar cubes. Build the model so that it has at least six layers. Suppose you were to continue to build the model: • How many sugar cubes would be in the 75th layer from the top? • How many sugar cubes would you need to construct a model with 100 layers? • Analyze this problem and create an algebraic model to describe this situation. Explain how you arrived at the algebraic model and how the algebraic model can be used to make predictions. Use an example to illustrate. ***www.mrsantowski.com/MCR3U/Assignments/M11SB207.pdf***
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)*

4 – I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Identifying mathematical patterns found in a sequence; identifying mathematical patterns found in a sequence; generating a sequence using an explicit formula; writing a recursive definition for a sequence; writing an explicit formula for a sequence; using formulas to find terms of a sequence
Exploration: Identifying arithmetic sequences; using the arithmetic mean; using an explicit formula for an arithmetic sequence; finding the common difference of an arithmetic sequence
Activity: Finding the common ratio of a geometric sequence; finding the sum of a series
Exploration: Determining whether a geometric series converges

Utilize resources from Chapter 9 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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Unit 10 – Relationships (6 blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **G.GPE.1** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- ✓ **G.GPE.2** Derive the equation of a parabola given a focus and directrix.
- ✓ **G.GPE.3** Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

Transfer

Students will be able to independently use their learning to…

- Explore and analyze the key features of equations to determine its graphical representation.

Meaning

UNDERSTANDINGS

Students will understand that…

- The shape of a hyperbola is guided by its asymptotes.
- The features of an equation directly affect the equation's graphical representation.
- Factoring is an essential tool in graphing conic sections.

ESSENTIAL QUESTIONS

- How is each method of constructing the different conics different?
- How does factoring help me graph conic sections?
- How are conic sections used in your life?
- How are man-made conics used to improve life?

Acquisition

Students will know…

Definition of:

- Axis of symmetry
- Center of a circle
- Center of a hyperbola
- Center of an ellipse
- Circle
- Conic section
- Conjugate axis
- Co-vertices of an ellipse
- Directrix
- Ellipse
- Focal length
- Focus of a parabola

Students will be skilled at…

- Graphing a circle
- Graphing an ellipse
- Graphing a hyperbola
- Identifying graphs of conics
- Graphing parabolas with x or y as the independent variable
- Writing equations of a parabola
- Writing equations of a circle
- Using translations to write an equation of a conic
- Using a graph to write the equation of a conic
- Finding the center and radius of a circle

	• Foci of an ellipse • Foci of a hyperbola • Hyperbola • Major axis • Minor axis • Radius • Standard form of an equation of a circle • Transverse axis • Vertices of an ellipse • Vertices of a hyperbola • Each point of a parabola is equidistant from a point called the focus and a line called the directrix. • In an x-y relationship, replacing x with x-h and y by y-k translates the graph of the relation h units horizontally and k units vertically. • There are four types of conic sections: parabolas, circles, ellipses, and hyperbolas. • A circle is a set of points a fixed distance from one point. • An ellipse "stretches" a circle and is the set of points that have a total fixed distance from two points.	• Writing equations of an ellipse • Finding the foci of an ellipse • Using the foci of an ellipse to write the equation • Using the foci of an ellipse to identify the major and minor axes • Writing equations of a hyperbola • Analyzing a hyperbola from its equation

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the	PERFORMANCE TASK(S): **SPACE EXPLORATION** The ratio of the distance between the center of a conic and one of its foci to the distance between the center and one of the vertices is called the eccentricity of a conic. a. Create several equations of ellipses and several equations of hyperbolas and determine the eccentricity of each ellipse and hyperbola. b. Make a conjecture comparing the eccentricity of ellipses to the eccentricity of hyperbolas.

<table>
<tr>
<td>task demonstrate application, innovation, and higher-level thinking.

3 – Applying
Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge.

2 – Developing
Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit.

1 – Beginning
Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.</td>
<td>c. State the equations of one other hyperbola and one other ellipse and determine their eccentricities. Does your conjecture prove true?
d. Investigate the eccentricity of the other conics and create a summary of your findings.
e. Submit a report showing all of your work that supports your summary.

http://www.mrsantowski.com/MCR3U/Assignments/M11SB640.pdf</td>
</tr>
<tr>
<td>Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts.

4 – I fully understand my learning and can explain connections. I am able to explain it to someone else.

3 – I understand my learning and can make some connections, but can use some help.

2 – I understand parts of my learning and need help making connections.</td>
<td>OTHER EVIDENCE:

Open-Ended (Formative) Assessment:
✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. (Synthesis, Analysis, Evaluation)
✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics.
✓ Homework Quick Checks (provided by textbook)
✓ Lesson Checks (provided by textbook)

Summative Assessment: Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section.
✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons.
✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.</td>
</tr>
</table>

1 – I do not understand my learning and cannot make connections, please help.	

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Graphing a circle; graphing an ellipse; graphing a hyperbola
Exploration: Identifying graphs of conics
Activity: Graphing parabolas with x or y as the independent variable; writing equations of a parabola; writing equations of a circle
Exploration: Using translations to write an equation of a conic; using a graph to write the equation of a conic
Activity: Finding the center and radius of a circle
Activity: Writing equations of an ellipse; finding the foci of an ellipse; using the foci of an ellipse to write the equation; using the foci of an ellipse to identify the major and minor axes
Activity: Writing equations of a hyperbola; analyzing a hyperbola from its equation

Utilize resources from Chapter 10 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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Unit 11 – Risk (5 blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **S.CP.3** 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.4** 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.
- ✓ **S.CP.5** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
- ✓ **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.
- ✓ **S.CP.8** Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.
- ✓ **S.MD.6** Use probabilities to make fair

Transfer

Students will be able to independently use their learning to…

- Design experiments, collect and organize data to address specific, real-world questions and evaluate the risks associated with the outcomes.

Meaning

UNDERSTANDINGS

Students will understand that…

- You can obtain valid statistical information about a population by studying a representative sample.
- Many common statistics are gathered from samples in the natural world tend to have a normal distribution about their mean.
- Probability is a way of predicting outcomes, but does not assure outcomes.
- Collecting information from a representative sample will help to directly make inferences about a population.
- The effectiveness of a survey is dependent on sampling techniques.
- Estimation is the foundation for making inferences.

ESSENTIAL QUESTIONS

- What is the difference between permutation and combination?
- How does the empirical probability relate to and differ from theoretical probability?
- How can the sampling methods of a study affect the quality of the results?
- Why are there restrictions on when you are able to utilize the Normal curve to evaluate risk?
- How are measures of central tendency different from standard deviation?

Acquisition

Students will know…

Definition of:

- Combination

Students will be skilled at…

- Finding permutations and combinations of data sets using formulas

decisions (e.g., drawing by lots, using a random number generator). ✓ **S.MD.7** Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). ✓ **S.IC.6** Evaluate reports based on data. ✓ **S.ID.4** 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. ✓ **S.IC.1** Understand statistics as a process for making inferences about population parameters based on a random sample from that population. ✓ **S.IC.3** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. ✓ **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. ✓ **S.IC.6** Evaluate reports based on data. ✓ **S.ID.2** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard	• Conditional probability • Experimental probability • Fundamental Counting Principle • Measure of central tendency • Mutually exclusive events • Normal distribution • Permutation • Simulation • Theoretical probability • Multiplication is a method used to count the number of ways certain things can happen. • The probability of an impossible event is 0 and a certain event is 1; otherwise a number between 0 and 1 represents risk. • To find the probability of two events occurring together, you have to decide whether one event occurring affects the other event's occurrence. • Conditional probability exists when two events are dependent. • Probability models are used to analyze situations and make fair decisions. • Various statistical measures, depending on what characteristics you are looking to analyze, can be used to describe and compare sets of data. • Standard deviation is a measure of how fair the number s in a data set deviate from the mean.	• Using the Fundamental Counting Principle • Identifying whether order is important • Using probability to evaluate outcomes of deviations • Using independence and conditional probability to interpret data • Using simulation to model experimental probability • Finding the theoretical probability of events using a formula • Using a tree diagram • Finding and analyze the measures of central tendency of given data sets • Finding the standard deviation of given data sets

deviation) of two or more different data sets. ✓ **S.IC.5** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.		

Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or	PERFORMANCE TASK(S): **On the Move** Surveys show that many people list traffic as one of their top problems. Creative people in the transportation industry are designing faster, safer, less expensive, and environmentally cleaner ways to get around. In Curitiba, Brazil, a highly efficient bus system uses design features of a modern subway to move people faster and more smoothly. In this project, you will identify a transportation problem. Then, you will design a new product or service to solve this problem. Finally, you will conduct a survey to decide whether your product or service is practical and marketable. *Activity 1: Interviewing* • Conduct a survey to identify a transportation problem in your community. • Choose the group of people you want to survey. • Design the survey. Before you write questions, decide what data you want to collect. You can collect data about types of transportation people use, how far or how often they use each type, and how satisfied they are. • Test the survey on a few people to make sure the questions are clear. Revise it if necessary. • Collect the data. *Activity 2: Analyzing* • Organize the data you gathered in the survey in Activity 1. • • Make graphs of the data. • • Calculate summary statistics. • • Use your graphs and summary statistics to analyze the data. • • List problems or issues revealed by your data.

collaboratively and does not work to best of ability.	*Activity 3: Designing* Suppose the members of your survey population are potential customers for your business. • What problem seems the most important to the people you surveyed? • Propose a product or service that could solve this problem. Be sure your idea is practical. Make a drawing, scale model, or written description of your new transportation product or service. Include a price or charge that you think is appropriate. Activity 4: Interviewing • Conduct a market survey for the transportation product or service you proposed. • In a series of interviews, identify your potential customers, what they want the product to do, and what changes they would like for the product. • Graph the data. Analyze your results. Should your business market this new product or service? If so, what changes should you make first, if any? Be sure you can defend your marketing decisions on the basis of the data you collected. The answers to the four activities should help you complete your project. Prepare a presentation that unveils the new product or service you invented and describes the results of your surveys. Present it to your classmates. Then discuss with them the marketing decision you made on the basis of your survey. Do they agree with your decision? *Prentice Hall: Algebra 2*
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections.	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics. ✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

1 – I do not understand my learning and cannot make connections, please help.	

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Finding permutations and combinations of data sets using formulas; using the Fundamental Counting Principle; identifying whether order is important.
Activity: Using probability to evaluate outcomes of deviations
Activity: Using independence and conditional probability to interpret data
Activity: Using simulation to model experimental probability
Activity: Finding the theoretical probability of events using a formula; using a tree diagram.
Exploration: Finding and analyzing the measures of central tendency of given data sets; find the standard deviation of given data sets

Utilize resources from Chapter 11 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

Randall, Charles, Basia Hall, Dan Kennedy, Allan E. Bellman, Sadie Chavis Bragg, William G. Handlin, Stuart J. Murphy, & Grant Wiggins. (2011). *Prentice Hall: Algebra 2.* Boston, MA: Pearson Education, Inc. Print.

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Unit 12– Trigonometry (8 blocks)
Stage 1 Desired Results

ESTABLISHED GOALS

- ✓ **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.
- ✓ **F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- ✓ **G.SRT.6** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
- ✓ **F.TF.1** Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- ✓ **F.IF.7.e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- ✓ **F.TF.2** Explain how the unit circle in

Transfer

Students will be able to independently use their learning to…

- Identify and analyze features of periodic functions to both construct and evaluate functions.

Meaning

UNDERSTANDINGS

Students will understand that…

- You can translate periodic functions in the same way that you translate other functions.
- Sine, cosine, and tangent are based on the radian measure of the unit circle.
- The Pythagorean Theorem and rules of special right triangles are vital tools in the computation of the values of sine, cosine, and tangent.

ESSENTIAL QUESTIONS

- How can you model periodic behavior?
- How do the characteristics of an equation determine the shape of its graph?
- How are sine, cosine, and tangent related?

Acquisition

Students will know…

Definition of:

- Amplitude
- Central angle
- Cosine
- Cycle
- Midline
- Period
- Periodic function
- Phase shift
- Radian
- Sine

Students will be skilled at…

- Identifying and exploring periodic behavior
- Identifying cycles and periods
- Identifying periodic functions
- Measuring and sketch angles in standard position
- Finding the values of cosine and sine of angles
- Finding cosine and sine of a radian measure
- Finding the length of an arc

the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measure angle traversed counterclockwise around the unit circle. ✓ **F.TF.5** Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. ✓ **F.TF.8** Prove the Pythagorean identity $\sin^2(\Theta) + \cos^2(\Theta) = 1$ and use it to find $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$ given find $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$ and the quadrant of the angle.	• Tangent • Unit circle • Periodic behavior is behavior that repeats over intervals of constant length. • The measure of an angle in standard position is the input for two important functions. The outputs are the coordinates (cosine and sine) of the point on the terminal side of the angle that is 1 unit from the origin. • An angle with full circle rotation measures 2π radians. • An angle with semicircle rotation measures π radians. • As the terminal side of an angle rotates about the origin (starting at 0^o), its sine value on the unit circle increases from 0 to 1, decreases from 1 to -1, and then increases back to 1. • The tangent function has infinitely many points of discontinuity with a vertical asymptote at each point. Its range is all real numbers. Its period is π, half that of both the sine and cosine functions. • Cosine, sine, and tangent have reciprocals. • Cosine and secant are reciprocals. • Sine and cosecant are reciprocals. • Tangent and cotangent are reciprocals.	• Graphing periodic functions • Using period functions' graphs to estimate values • Writing the formulas of trigonometric functions • Finding amplitude, midline, period, minimums, and maximums of trigonometric functions • Identifying phase shifts • Graphing translations • Finding the value of the reciprocal trigonometric functions based on the corresponding trigonometric functions
Stage 2 - Evidence		
Evaluative Criteria	**Assessment Evidence**	

Suggested Performance Rubric: Use the following or similar rubric to evaluate a student's performance on performance tasks: **4 – Innovating** Student is able to apply knowledge learned during the unit, work individually or collaboratively, and show effort. All steps of the task demonstrate application, innovation, and higher-level thinking. **3 – Applying** Student works individually and collaboratively and shows effort. All steps of the assignment demonstrate that the student can apply new knowledge. **2 – Developing** Student is able to work individually or collaboratively most of the time, and shows some effort. The steps in the assignment demonstrate that the student can apply most of the knowledge learned throughout the unit. **1 – Beginning** Student is only able to apply new knowledge learned during the unit with assistance. Student has difficulty working individually or collaboratively and does not work to best of ability.	PERFORMANCE TASK(S): **Amusement Rides** A popular ride at an amusement park is called the "Ring of Terror." It is like a Ferris wheel but is inside a haunted house. Riders board a platform at the center of the "ring" and the ring moves counterclockwise. When a rider is moving above the platform, he or she meets flying creatures and when the seat descends to a level below the platform, creatures emerge from a murky, slimy pit. The radius of the ring is 6 m. a. Graph the height of a rider with respect to the platform through three revolutions of the ride. b. Create an equation to model the motion of a person in the ride. c. How would your graph and equation change if the rider got on the ride in the pit, at the bottom of the ring? Explain. ***http://www.mrsantowski.com/MCR3U/Assignments/M11SB555.pdf***
Suggested Monitoring Scale: Use the following or similar scale to monitor or evaluate a student's daily learning and understanding of key concepts. **4 –** I fully understand my learning and can	OTHER EVIDENCE: **Open-Ended (Formative) Assessment:** ✓ Homework is assigned daily, from the textbook, Chapter Resource Practice Workbook, or other sources. *(Synthesis, Analysis, Evaluation)* ✓ Introductory and Closing Activities will be done every day to pre-assess student knowledge and assess understanding of topics.

explain connections. I am able to explain it to someone else. **3 –** I understand my learning and can make some connections, but can use some help. **2 –** I understand parts of my learning and need help making connections. **1 –** I do not understand my learning and cannot make connections, please help.	✓ Homework Quick Checks (provided by textbook) ✓ Lesson Checks (provided by textbook) **Summative Assessment:** Assessment questions should be open-ended and should follow the general format illustrated in the Essential Questions/Sample Conceptual Understanding section. ✓ Students will be given quizzes that provide a brief review of the concepts and skills in the previous lessons. ✓ Students will be given a chapter test that provides a review of the concepts and skills in the chapter.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Pre-Assessment

Students will complete a short collection of open-ended response problems on the topics presented in the unit. The data from this pre-assessment will be utilized to plan and differentiate instruction to meet the needs of diverse learners. In addition, the pre-assessment should be used to identify the readiness levels and background of knowledge relating to the concepts presented in the unit.

Learning Plan

Activity: Identifying and exploring periodic behavior; identifying cycles and periods; identifying periodic functions
Activity: Measuring and sketching angles in standard position
Exploration: Finding the values of cosine and sine of angles; finding cosine and sine of a radian measure; finding the length of an arc
Graph periodic functions. Use period functions' graphs to estimate values
Activity: Writing the formulas of trigonometric functions
Exploration: Finding amplitude, midline, period, minimums, and maximums of trigonometric functions; identifying phase shifts; graphing translations
Activity: Finding the value of the reciprocal trigonometric functions based on the corresponding trigonometric functions

Utilize resources from Chapter 13 including:

- Think About a Plan
- Practice
- Standardized Test Prep
- Homework Quick Check
- Lesson Checks
- Activities, Games, and Puzzles from the Online Teacher Resource Center
- Utilize *Reteach*, *Enrichment,* and *ELL Support* resources to differentiate instruction

Additional Resources:

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Benchmark Assessment Quarter 1

1. Students will model real world situations utilizing linear and non-linear models.
2. Students will solve equations and inequalities.
3. Students will identify and apply transformations to parent graphs to create a new, unique graph.
4. Students will solve a system of either linear or nonlinear equations utilizing a variety of methods.
5. Students will solve a system of either linear or nonlinear inequalities utilizing by graphing to find a solution.
6. Students will represent quadratic equations in vertex, standard, and intercept form.
7. Students will understand the concept of the complex plane and utilize it in computation of solutions to a quadratic equation.

Benchmark Assessment Quarter 2

1. Students will write a polynomial function given a polynomial equation.
2. Students will identify the degree of a polynomial equation.
3. Students will identify the highest power of a polynomial function.
4. Students will write a polynomial given its factors or zeros.
5. Students will identify key features of a polynomial and be able to compare it to its related polynomial function.
6. Students will find the real roots of a polynomial function utilizing a variety of methods.
7. Students will be able construct a polynomial using key features of its graph.
8. Students will factor a polynomial equation.
9. Students will apply the Zero-Product Property.
10. Students will simplify radical expressions.
11. Students will solve radical equations.
12. Students will determine the domain of radical functions.
13. Students will check for extraneous solutions.
14. Students will find inverse functions.
15. Students will graph functions and their inverses.

Benchmark Assessment Quarter 3

1. Students will model situations with exponential functions.
2. Students will use exponents to solve logarithmic equations.
3. Students will use logarithms to solve exponential equations.
4. Students will show that exponents and logarithms are inverse functions.
5. Students will graph exponential and logarithmic functions.
6. Students will graph asymptotes of rational functions.
7. Students will identify whether a rational function has an asymptote.
8. Students will differentiate between vertical, horizontal, and oblique asymptotes.
9. Students will define the domains of simplified rational expressions to make them equivalent to the originals.

Benchmark Assessment Quarter 4

1. Students will identify mathematical patterns found in a sequence.
2. Students will find a rule to describe a pattern.
3. Students will find the common difference of an arithmetic sequence.
4. Students will find the common ratio of a geometric sequence.
5. Students will determine whether a geometric series converges.
6. Students will identify the possible conic sections formed depending on the angle of intersection of the cone and plane.
7. Students will graph functions of circles.
8. Students will identify conic sections based on their equations.
9. Students will differentiate between ellipses and hyperbolas algebraically and graphically.
10. Students will find permutations and combinations of data sets using formulas.
11. Students will use simulation to model experimental probability.
12. Students will find the theoretical probability of events using a formula.
13. Students will find and analyze the measures of central tendency of given data sets.
14. Students will find the standard deviation of given data sets.
15. Students will identify and explore periodic behavior.
16. Students will graph periodic functions.
17. Students will write the formulas of trigonometric functions.
18. Students will find amplitude, period, minimums, and maximums of trigonometric functions.