High School College Algebra B Curriculum

Course Description: The class consists of Math 120, College Algebra from the Metropolitan Community College for 3 hours college credit. The catalog description for Math 120 is a study of various types of equations and inequalities, functions and their inverses, theory of higher degree equations, systems of equations, determinants, logarithmic and exponential functions, conic sections, sequences and series, and the Binomial Theorem.

Scope and Sequence:

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<tr>
<th>Timeframe</th>
<th>Unit</th>
<th>Instructional Topics</th>
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<tr>
<td>12 class periods</td>
<td>Equations and Graphs</td>
<td>Topic 1: Simplifying&lt;br&gt;Topic 2: Graphing&lt;br&gt;Topic 3: Solving and Applying&lt;br&gt;Topic 4: Writing Functions</td>
</tr>
<tr>
<td>13 class periods</td>
<td>Functions</td>
<td>Topic 1: Functions and Graphs&lt;br&gt;Topic 2: Analyzing Functions&lt;br&gt;Topic 3: Combining Functions&lt;br&gt;Topic 4: Inverse Functions</td>
</tr>
<tr>
<td>13 class periods</td>
<td>Polynomials and Rationals</td>
<td>Topic 1: Polynomial Functions&lt;br&gt;Topic 2: Rational Functions</td>
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<tr>
<td>11 class periods</td>
<td>Exponentials and Logarithms</td>
<td>Topic 1: Exponential Functions&lt;br&gt;Topic 2: Logarithmic Functions&lt;br&gt;Topic 3: Solve and Apply</td>
</tr>
<tr>
<td>18 class periods</td>
<td>Conics and Systems of Equations</td>
<td>Topic 1: Conic Sections&lt;br&gt;Topic 2: Systems of Equations</td>
</tr>
<tr>
<td>8 class periods</td>
<td>Systems and Matrices</td>
<td>Topic 1: Matrices</td>
</tr>
</tbody>
</table>
Unit 1: Equations and Graphs

Subject: College Algebra B
Grade: 10, 11, 12
Name of Unit: Equations and Graphs
Length of Unit: 12 class periods
Overview of Unit: In this unit, students will solve and apply equations of one variable, graph and write equations of lines, and utilize the concepts of set theory and operations when evaluating an expression or communicating a solution.

Priority Standards for unit:
- Alg2.REI.A.1: Create and solve equations and inequalities, including those that involve absolute value.
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting Standards for unit:
- Alg2.REI.A.2: Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.
- ISTE-KNOWLEDGE COLLECTOR.3.D - build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb’s DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>equations and inequalities, including those that involve absolute value.</td>
<td>Create</td>
<td>Create</td>
<td>3</td>
</tr>
<tr>
<td>equations and inequalities, including those that involve absolute value</td>
<td>Solve</td>
<td>Apply</td>
<td>2</td>
</tr>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Identify</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Interpret</td>
<td>Analyze</td>
<td>3</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How do you use interval notation to communicate solutions?
2. How do you graph a variety of functions?
3. How do you determine the appropriate method for solving a variety of equations?
4. How do you use the properties of real numbers to evaluate expressions?
5. How do we use given information to write the equation of a line?
6. How do you solve a quadratic equation/inequality?

**Enduring Understanding/Big Ideas:**
1. Write solutions from the smallest endpoint to the largest endpoint using parentheses or brackets correctly.
2. Graphing linear, quadratic, absolute value, and square root functions.
3. Applying a variety of methods to solve linear, quadratic, absolute value, radical and rational equations, checking for extraneous solutions when appropriate.
4. They are used to make computations easier and quicker than relying just on the order of operations.
5. Write linear equations using point-slope, slope intercept, and standard form.
6. Using factoring, completing the square, the quadratic formula or graphing to solve a quadratic equation/inequality and writing the answer in interval notation when appropriate.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinate Plane</td>
<td>Family of functions</td>
</tr>
<tr>
<td>Intercepts</td>
<td>Quadratic</td>
</tr>
<tr>
<td>Symmetry</td>
<td>Factoring</td>
</tr>
<tr>
<td>Slope</td>
<td>Discriminant</td>
</tr>
<tr>
<td>Parallel</td>
<td>Polynomial</td>
</tr>
<tr>
<td>Perpendicular</td>
<td>Quadratic Type</td>
</tr>
<tr>
<td>Rate of Change</td>
<td>Inequalities</td>
</tr>
<tr>
<td></td>
<td>Absolute Value</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Topic 1: Simplifying

Engaging Experience 1
Title: Set Activity
Suggested Length of Time: 15 minutes
Standards Addressed

  Priority:
  
  • Alg2.REI.A.1: Create and solve equations and inequalities, including those that involve absolute value.

Detailed Description/Instructions: Teacher will call out common traits among students in the class to make a set of students in the class. Based on what instructions are called out, students will stand or sit, demonstrating concepts of subsets, elements, unions, and intersections.

Bloom’s Levels: Create and Apply
Webb’s DOK: 3, 2
Engaging Experience 1
Title: Get Moving
Suggested Length of Time: 10 minutes

Standards Addressed

Priority:

- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Detailed Description/Instructions: Teacher will call out a variety of functions and students will “model” these functions using their bodies/arms.

Bloom’s Levels: Understand, Analyze
Webb’s DOK: 2, 3
**Engaging Experience 1**

**Title:** Guided Practice  
**Suggested Length of Time:** 30 minutes  
**Standards Addressed**

*Priority:*
- Alg2.REI.A.1: Create and solve equations and inequalities, including those that involve absolute value.

*Supporting:*
- Alg2.REI.A.2: Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.

**Detailed Description/Instructions:** Students will be paired up. Each student will get a whiteboard. The teacher will give an equation to solve, in one variable. Each student will solve the equation, compare answers, check their solutions, find mistakes, etc. This process will continue on with a variety of types of equations (linear, quadratic, absolute value, rational, radical, etc.).

**Bloom’s Levels:** Create, Apply  
**Webb’s DOK:** 3, 2
Engaging Experience 1
Title: Writing Equations of Lines Line-Up
Suggested Length of Time: 15-20 minutes
Standards Addressed

*Priority:*

- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

**Detailed Description/Instructions:** Students will be given a card that has given information about their line. This might be a point and a slope, two points, or information about a parallel/perpendicular line. Students will find the equation of their line, written in slope-intercept form. Afterwards, they will line up from smallest \(y\)-intercept to largest \(y\)-intercept. Count the number of mistakes (if any) and have students complete the problem of the person standing next to them to check for accuracy.

**Bloom’s Levels:** Analyze

**Webb’s DOK:** 3
Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)
Mix It Up - In this activity, students will work with mixtures of two colors of beads to understand the effect of combining two different mixtures to predict the percent concentration of the final mixture.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplifying</td>
<td>Set Activity</td>
<td>Teacher will call out common traits among students in the class to make a set of students in the class. Based on what instructions are called out, students will stand or sit, demonstrating concepts of subsets, elements, unions, and intersections.</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Graphing</td>
<td>Get Moving</td>
<td>Teacher will call out a variety of functions and students will “model” these functions using their bodies/arms.</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Solving and Applying</td>
<td>Guided Practice</td>
<td>Students will be paired up. Each student will get a whiteboard. The teacher will give an equation to solve, in one variable. Each student will solve the equation, compare answers, check their solutions, find mistakes, etc. This process will continue on with a variety of types of equations (linear, quadratic, absolute value, rational, radical, etc.).</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Writing Functions</td>
<td>Writing Equations of Lines Line-Up</td>
<td>Students will be given a card that has given information about their line. This might be a point and a slope, two points, or information about a parallel/perpendicular line. Students will find the equation of their line, written in slope-intercept form. Afterwards, they will line up from smallest y-intercept to largest y-intercept. Count the number of mistakes (if any) and have students complete the problem of the person standing next to them to check for accuracy.</td>
<td>15-20 minutes</td>
</tr>
</tbody>
</table>
Unit 2: Functions

Subject: College Algebra B
Grade: 10, 11, 12
Name of Unit: Functions
Length of Unit: 13 class periods
Overview of Unit: Students will graph a variety of functions use domain, range, tables, and transformations. Students will use function notation to combine functions, find average rate of change, and determine if a function has symmetry. Students will find inverses to a function algebraically, graphically and numerically.

Priority Standards for unit:
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
- Alg2.BF.A.1: Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).
- Alg2.BF.A.2: Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.

Supporting Standards for unit:
- Alg2.BF.A.3: Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- ISTE-EMPOWERED LEARNER1.D - understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies
- ISTE-KNOWLEDGE COLLECTOR.3.D - build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

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<th>Webb's DOK</th>
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</thead>
<tbody>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Identify</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Interpret</td>
<td>Analyze</td>
<td></td>
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<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
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<td>3</td>
</tr>
<tr>
<td>Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).</td>
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<td>2</td>
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<tr>
<td>Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).</td>
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<td>1</td>
</tr>
<tr>
<td>Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.</td>
<td></td>
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<td>3</td>
</tr>
</tbody>
</table>

**Essential Questions:**

1. How can you represent a function in a variety of ways?
2. How can you find the domain and range of a function and use that to graph a given function?
3. How can you analyze the graph of a function?
4. How do you combine functions?
5. How do you find the inverse of a function?

**Enduring Understanding/Big Ideas:**

1. Represent a function verbally, algebraically, graphically and numerically, using function notation when appropriate.
2. Determine the domain and range of a function, use the information to graph a variety of functions including piecewise functions.
3. Using the graph of a function to apply transformations, find optimal values and determine the average rate of change.
4. Use the basic operations to combine functions to obtain new functions and finding the composition of functions.
5. Finding the inverse of 1-1 functions and proving that functions are inverses of each other.
Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
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</thead>
<tbody>
<tr>
<td>Function</td>
<td>Domain</td>
</tr>
<tr>
<td>Independent Variable</td>
<td>Range</td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>Piecewise Function</td>
</tr>
<tr>
<td>Net Change</td>
<td>Even and Odd Functions</td>
</tr>
<tr>
<td>Maxima</td>
<td>Composition</td>
</tr>
<tr>
<td>Minima</td>
<td>One to One</td>
</tr>
<tr>
<td>Average Rate of Change</td>
<td>Horizontal Line Test</td>
</tr>
<tr>
<td>Transformations</td>
<td></td>
</tr>
<tr>
<td>Inverse</td>
<td></td>
</tr>
</tbody>
</table>

Resources for Vocabulary Development: Textbook
Engaging Experience 1

Title: Just Move it - Desmos

Suggested Length of Time: 45 minutes

Standards Addressed

Priority:

- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:

- Alg2.BF.A.3: Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- ISTE-EMPOWERED LEARNER1.D - understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies

Detailed Description/Instructions: Students will complete the Move It - Transformations activity on Desmos.

Bloom’s Levels: Understand, Analyze

Webb’s DOK: 2, 3
Topic 2: Analyzing Functions

Engaging Experience 1

Title: Cell Phone Activity

Suggested Length of Time: 30 minutes

Standards Addressed

Priority:

- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:

- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- ISTE-KNOWLEDGE COLLECTOR.3.D - build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

Detailed Description/Instructions: After being introduced to the idea of a piecewise function students will be given a cell phone scenario with 2-3 different plans (for example plan A: $30 monthly fee, 450 anytime minutes, $.45 for each additional minute, plan B: $45 monthly fee, 900 anytime minutes, $.30 for each additional minute). Students will be given a task to create a piecewise function to represent each scenario, then answer questions about which is the best plan if you use 400 minutes each month, 475,600, etc., verifying this both graphically and algebraically.

Bloom’s Levels: Understand, Analyze

Webb’s DOK: 2, 3
Engaging Experience 1
Title: Chain Reaction
Suggested Length of Time: 15 minutes
Standards Addressed
  Priority:
  • Alg2.BF.A.1: Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).
  Supporting:
  • NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.

Detailed Description/Instructions: Students will be divided into groups of 4 or 5 and labeled with a number 1-5 (for groups of 4 one person will go twice). The teacher will prepare 5 functions (using a variety of ones discussed - quadratic, linear, square root, etc.) and print these same 5 functions on note cards for each of the groups in the class. Each group will receive the set of 5 functions and distribute them to their group members in random order. The teacher will then call out a number, for example -1. The 1 student in each group will evaluate his/her function at that value, the 2 students will then evaluate his/her function at the answer to student 1’s function. This will continue on until all 5 functions have been evaluated. Answers will be checked, and students will then have an opportunity to go back and fix their chain if they were wrong. This is a good lead into discussing the composition of functions.

Bloom’s Levels: Apply
Webb’s DOK: 2
Engaging Experience 1
Title: Inverse Function Partner Share
Suggested Length of Time: 30 minutes
Standards Addressed
  Priority:
  - Alg2.BF.A.2: Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.
  Supporting:
  - NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together
Detailed Description/Instruction: The teacher will begin by writing a function on the board (for example $3x^2 + 1$) and as a class they should generate the sequence of steps needed to evaluate the function (1 - square the input, 2 - multiply by 3, 3 - add 1). From here the class will divide into teams of 2. Each team of two will be given two different functions that are not inverses of each other, however another team should have functions that are inverses of another team’s functions. Students should write out the sequence of steps for each of their functions and provide 3 ordered pairs which satisfy their functions. Once each team is done, they should seek out a team that mirrors their steps. Once they have found their other half, they should discuss what they notice about their functions (the steps are in the opposite order - steps are “undone”, they should notice their ordered pairs are also reversed). This should lead to a class discussion of what an inverse is, the process of finding an inverse, and the domain-range relationship between functions and their inverses.
Bloom’s Levels: Apply, Apply
Webb’s DOK: 2, 3
Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.) Use Function Carnival from Desmos Teacher Activities to have students put different parent functions together in a piecewise function. Students will also need to use the concepts of increasing and decreasing intervals to identify where to place maximum and minimum points.
# Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions and Graphs</td>
<td>Just Move it - Desmos</td>
<td>Students will complete the Move It - Transformations activity on Desmos.</td>
<td>45 minutes</td>
</tr>
<tr>
<td>Analyzing Functions</td>
<td>Cell Phone Activity</td>
<td>After being introduced to the idea of a piecewise function students will be given a cell phone scenario with 2-3 different plans (for example plan A: $30 monthly fee, 450 anytime minutes, $.45 for each additional minute, plan B: $45 monthly fee, 900 anytime minutes, $.30 for each additional minute). Students will be given a task to create a piecewise function to represent each scenario, then answer questions about which is the best plan if you use 400 minutes each month, 475,600, etc., verifying this both graphically and algebraically.</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Combining Functions</td>
<td>Chain Reaction</td>
<td>Students will be divided into groups of 4 or 5 and labeled with a number 1-5 (for groups of 4 one person will go twice). The teacher will prepare 5 functions (using a variety of ones discussed - quadratic, linear, square root, etc.) and print these same 5 functions on note cards for each of the groups in the class. Each group will receive the set of 5 functions and distribute them to their group members in random order. The teacher will then call out a number, for example -1. The 1 student in each group will evaluate his/her function at that value, the 2 students will then evaluate his/her function at the answer to student 1’s function. This will continue on until all 5 functions have been evaluated. Answers will be checked, and students will then have an opportunity to go</td>
<td>15 minutes</td>
</tr>
</tbody>
</table>
back and fix their chain if they were wrong. This is a good lead into discussing the composition of functions.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse Functions</td>
<td>The teacher will begin by writing a function on the board (for example $3x^2 + 1$) and as a class they should generate the sequence of steps needed to evaluate the function (1 - square the input, 2 - multiply by 3, 3 - add 1). From here the class will divide into teams of 2. Each team of two will be given two different functions that are not inverses of each other, however another team should have functions that are inverses of another team’s functions. Students should write out the sequence of steps for each of their functions and provide 3 ordered pairs which satisfy their functions. Once each team is done, they should seek out a team that mirrors their steps. Once they have found their other half, they should discuss what they notice about their functions (the steps are in the opposite order - steps are “undone”, they should notice their ordered pairs are also reversed). This should lead to a class discussion of what an inverse is, the process of finding an inverse, and the domain-range relationship between functions and their inverses.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 3: Polynomials and Rationals

Subject: College Algebra B
Grade: 10, 11, 12
Name of Unit: Polynomials and Rationals
Length of Unit: 13 class periods
Overview of Unit: Students will graph polynomials and rational functions using domain, end behavior, and intercepts. Students will find all zeros of polynomial including complex zeros and multiplicity of zeros.

Priority Standards for unit:
- Alg2.NQ.B.3: Know and apply the Fundamental Theorem of Algebra.
- Alg2.APR.A.5: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting Standards for unit:
- Alg2.APR.A.1: Extend the knowledge of factoring to include factors with complex coefficients.
- Alg2.APR.A.2: Understand the Remainder Theorem and use it to solve problems.
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.
- NMP.FF.1 Conceptualize quantities and define variables that are present in a given situation.
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- NMP.FF.3 Measure, compute, describe, and interpret rates of change of quantities embedded in multiple representations.
- ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
- ISTE-KNOWLEDGE COLLECTOR.3.A - plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>the Fundamental Theorem of Algebra</td>
<td>Know</td>
<td>Remember</td>
<td>1</td>
</tr>
<tr>
<td>the Fundamental Theorem of Algebra</td>
<td>Apply</td>
<td>Apply</td>
<td>3</td>
</tr>
<tr>
<td>zeros of polynomials when suitable factorizations are available</td>
<td>Identify</td>
<td>Understand</td>
<td>1</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
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</tr>
<tr>
<td>the zeros to sketch the function defined by the polynomial.</td>
<td>Use</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Identify</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Interpret</td>
<td>Analyze</td>
<td>3</td>
</tr>
</tbody>
</table>

**Essential Questions:**
1. How can the number of solutions to a polynomial be determined?
2. How can the end behavior of a polynomial be determined?
3. How do domain issues affect the graph of a rational function?
4. How can the end behavior of a rational function be determined?

**Enduring Understanding/Big Ideas:**
1. The degree of the polynomial determines the number of the solutions.
2. The degree and Leading Coefficient determine the end behavior.
3. Values not in the domain are either a hole or a vertical asymptote.
4. The end behavior will be determined by dividing quotient.
### Unit Vocabulary:

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<thead>
<tr>
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<th>Content/Domain Specific</th>
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</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>End behavior</td>
</tr>
<tr>
<td>Minimum</td>
<td>Zero</td>
</tr>
<tr>
<td>Domain</td>
<td>Polynomial</td>
</tr>
<tr>
<td>Range</td>
<td>Rational</td>
</tr>
<tr>
<td>Quotient</td>
<td>Synthetic Division</td>
</tr>
<tr>
<td>Remainder</td>
<td>Degree</td>
</tr>
<tr>
<td>Joint Variation</td>
<td>Leading Coefficient</td>
</tr>
<tr>
<td>Inverse Variation</td>
<td>Asymptote</td>
</tr>
<tr>
<td>Direct Variation</td>
<td>Quadratic</td>
</tr>
<tr>
<td>Proportional</td>
<td>Complex Number</td>
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<tr>
<td>Constant</td>
<td>Roots</td>
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<tr>
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<td>Multiplicity</td>
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<tr>
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<td>Intercepts</td>
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<tr>
<td></td>
<td>Bounds</td>
</tr>
<tr>
<td></td>
<td>Conjugate</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** to be created

Textbook
Topic 1: Polynomial Functions

Engaging Experience 1
Title: Real World Extrema Problems
Suggested Length of Time: 1 class period
Standards Addressed
  Priority:
  - Alg2.APR.A.5: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.
  - Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
  Supporting:
  - Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.
  - NMP.FF.1 Conceptualize quantities and define variables that are present in a given situation.
Detailed Description/Instructions: Students will be given different scenarios that require them to write a quadratic function to represent the problem. They will then use the equation to determine the optimal solution (max profit, min fencing, etc.)
Bloom’s Levels: Identify, Use, Analyze
Webb’s DOK: 1, 2, 3

Engaging Experience 2
Title: Analyze the Graphs of Polynomials
Suggested Length of Time: 1 class periods
Standards Addressed
  Priority:
  - Alg2.APR.A.5: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.
  - Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
  Supporting:
  - ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
Detailed Description/Instructions: Students will use end behavior and multiplicity of zeros to graph several polynomials. The students then will use technology (graphing calculator or Desmos) to verify their answers.
Bloom’s Levels: Identify, Use, Analyze; Webb’s DOK: 1, 2, 3
**Engaging Experience 3**

**Title:** Finding Zeros of Polynomials

**Suggested Length of Time:** 2 class periods

**Standards Addressed**

*Priority:* Alg2.IF.A.1:
- Alg2.NQ.B.3: Know and apply the Fundamental Theorem of Algebra.
- Alg2.APR.A.5: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.

*Supporting:*  
- Alg2.APR.A.1: Extend the knowledge of factoring to include factors with complex coefficients.
- Alg2.APR.A.2: Understand the Remainder Theorem and use it to solve problems.
- ISTE-KNOWLEDGE COLLECTOR.3.A - plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

**Detailed Description/Instructions:** Students will be given a variety of polynomial functions and be asked to use technology and theorems (possible rational zeros, Descartes’ Rule of signs, and bounds) to determine potential zeros of the function. They will then use synthetic or polynomial division to reduce the function and identify zeros. Some zeros will be complex.

**Bloom’s Levels:** Analyze

**Webb’s DOK:** 3
Engaging Experience 1
Title: Analyze Rational Functions
Suggested Length of Time: 1 class period

Standards Addressed

Priority:
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:
- ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

Detailed Description/Instructions:
Students will be tasked with taking a variety of rational functions and analyzing them to find domain, range, holes, asymptotes, end behavior, intercepts, and extrema. They will then create graphs of these functions both by hand and with the assistance of technology.

Bloom’s Levels: Analyze
Webb’s DOK: 3

Engaging Experience 2
Title: Variation
Suggested Length of Time: 1 class period

Standards Addressed

Priority:
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- NMP.FF.3 Measure, compute, describe, and interpret rates of change of quantities embedded in multiple representations.

Detailed Description/Instructions: Students will work on getting a better understanding of the relationship between variable. Students will be given a scenario and will find an equation and determine future data points using that equation. Potential scenarios could include applying gas laws, or the gravitational force between two masses, or scenarios involving movement and examining acceleration or deceleration.

Bloom’s Levels: Analyze
Webb’s DOK: 3
Engaging Scenario

Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.) Students will be broken into groups and given sheets of paper of various sizes. They will construct an open topped box of maximum volume. Their product will be a physical box, the equation modeling their boxes volume, a screenshot of technology showing values of the maximum, and a justification of their findings.

The students then will find the two values they could have cut out to make a box of half the volume. If their solution can be found without technology, they must show the work by hand.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polynomial Functions</td>
<td>Real World Extrema Problems</td>
<td>Students will be given different scenarios that require them to write a quadratic function to represent the problem. They will then use the equation to determine the optimal solution (max profit, min fencing, etc…)</td>
<td>1 class period</td>
</tr>
<tr>
<td>Polynomial Functions</td>
<td>Analyze the Graphs of Polynomials</td>
<td>Students will use end behavior and multiplicity of zeros to graph several polynomials. The students then will use technology (graphing calculator or Desmos) to verify their answers.</td>
<td>1 class period</td>
</tr>
<tr>
<td>Polynomial Functions</td>
<td>Finding Zeros of Polynomials</td>
<td>Students will be given a variety of polynomial functions and be asked to use technology and theorems (possible rational zeros, Descartes’ Rule of signs, and bounds) to determine potential zeros of the function. They will then use synthetic or polynomial division to reduce the function and identify zeros. Some zeros will be complex.</td>
<td>2 class periods</td>
</tr>
<tr>
<td>Rational Functions</td>
<td>Analyze Rational Functions</td>
<td>Students will be tasked with taking a variety of rational functions and analyzing them to find domain, range, holes, asymptotes, end behavior, intercepts, and extrema. They will then create graphs of these functions both by hand and with the assistance of technology.</td>
<td>1 class period</td>
</tr>
<tr>
<td>Rational Functions</td>
<td>Variation</td>
<td>Students will work on getting a better understanding of the relationship between variable. Students will be given a scenario and will find an equation and determine future data points using that equation. Potential scenarios could include applying gas laws, or the gravitational force between two masses, or scenarios involving movement and examining acceleration or deceleration.</td>
<td>1 class period</td>
</tr>
</tbody>
</table>
Unit 4: Exponentials and Logarithms

Subject: College Algebra B
Grade: 10, 11, 12
Name of Unit: Exponentials and Logarithms
Length of Unit: 11 class periods
Overview of Unit: Students will graph exponential and logarithmic functions using characteristics of each function. Students will solve exponential and logarithmic equations. Students will apply exponential and logarithmic functions to solve real world applications.

Priority Standards for unit:
- Alg2.SSE.A.1: Develop the definition of logarithms based on properties of exponents.
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting Standards for unit:
- Alg2.SSE.A.2: Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.
- Alg2.SSE.A.3: Use properties of logarithms to solve equations or find equivalent expressions.
- Alg2.SSE.A.4: Understand why logarithmic scales are used, and use them to solve problems.
- Alg2.IF.A.2: Translate between equivalent forms of functions.
- Alg2.BF.A.3: Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- ISTE-COMPUTATIONAL THINKER.5.B - collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
- ISTE-KNOWLEDGE COLLECTOR.3.A - plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>the definition of logarithms based on properties of exponents</td>
<td>Develop</td>
<td>Understand</td>
<td>4</td>
</tr>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Identify</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.</td>
<td>Interpret</td>
<td>Analyze</td>
<td>3</td>
</tr>
</tbody>
</table>

**Essential Questions:**
1. Why do exponential functions have a horizontal asymptote?
2. How are exponential and logarithmic functions related?
3. How do we evaluate a logarithmic function? (What is a logarithm?)
4. How do we apply exponential functions to the real world?
5. How do we apply logarithmic functions to the real world?

**Enduring Understanding/Big Ideas:**
1. As the exponent gets closer to negative infinity, the value gets closer to 0.
2. Exponential and logarithmic functions are inverse functions.
3. You rewrite the logarithm as an exponential and find the exponent. (It is an exponent.)
4. They are used to model exponential growth and compound interest.
5. They are used to solve exponential growth and compound interest problems. They are also used to model intensity of sound, earthquakes, and acidity of liquids.
**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponential Growth</td>
<td>Logarithmic</td>
</tr>
<tr>
<td>Decay</td>
<td>Asymptote</td>
</tr>
<tr>
<td>Domain</td>
<td>Intercepts</td>
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<tr>
<td>Range</td>
<td>Property</td>
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<td>Constant</td>
<td>Transformations</td>
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<td>Laws</td>
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<td></td>
<td>Base</td>
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<td></td>
<td>Exponent</td>
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<td></td>
<td>Initial Value</td>
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<td></td>
<td>Population</td>
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<td></td>
<td>Difference</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1
Title: Graphing Exponential Functions
Suggested Length of Time: 1 class period
Standards Addressed

Priority:
• Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:
• Alg2.BF.A.3: Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.

Detailed Description/Instructions: Students will be giving several exponential functions of any base including e to graph without the aid of a graphing utility. Students will graph these functions by using transformations and key characteristics common to all exponential functions such as domain, range, the horizontal asymptote, and key points.

Bloom’s Levels: Understand
Webb’s DOK: 2
Engaging Experience 1

Title: Develop an Understanding of Logarithms

Suggested Length of Time: 1/2 class period

Standards Addressed

Priority:

- Alg2.SSE.A.1: Develop the definition of logarithms based on properties of exponents.

Supporting:

- Alg2.SSE.A.2: Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.
- Alg2.IF.A.2: Translate between equivalent forms of functions.
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- Alg2.SSE.A.3: Use properties of logarithms to solve equations or find equivalent expressions.

Detailed Description/Instructions: Students will convert logarithmic expressions into exponential functions with an unknown exponent. The students will then use the properties of exponents to solve for the missing exponent.

Bloom’s Levels: Understand

Webb’s DOK: 4

Engaging Experience 2

Title: Graph Logarithms

Suggested Length of Time: 1/2 class period

Standards Addressed

Priority:

- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:

- Alg2.BF.A.3: Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
Detailed Description/Instructions: Students will use the graph of an exponential functions and the properties and symmetry of inverse functions to develop the graphs of logarithms of any base and state key characteristics such as domain, range, vertical asymptote, and key points. The students then will be asked to graph several logarithmic functions using transformations and then compare their graphs to a graphing utility and note the limitations of the graphing utility.

Bloom’s Levels: Understand
Webb’s DOK: 2

Engaging Experience 3
Title: Use Properties of Logarithms
Suggested Length of Time: 1/2 class period

Standards Addressed

Priority:
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:
- Alg2.BF.A.3: Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
- ISTE-COMPUTATIONAL THINKER.5.B - collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Detailed Description/Instructions: Students will use the properties of logarithms to expand and condense expressions. To verify their work, students will be given functions and will graph the original functions and the expanded or condensed expression in the same window of a graphing utility to verify the functions are equivalent.

Bloom’s Levels: Understand
Webb’s DOK: 2
Topic 3: Solve and Apply

Engaging Experience 1
Title: Solving Exponential and Logarithmic Equations Using a Variety of Methods
Suggested Length of Time: 2 class periods
Standards Addressed

Priority:
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:
- Alg2.SSE.A.2: Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.
- Alg2.SSE.A.3: Use properties of logarithms to solve equations or find equivalent expressions.

Detailed Description/Instructions: Students will be given exponential and logarithmic functions in a variety of formats. They will be asked to use their knowledge of the inverse relationship of the functions and exponentials and logarithmic properties to solve those equations.

Bloom’s Levels: Apply
Webb’s DOK: 3

Engaging Experience 2
Title: Exponential Growth and Decay
Suggested Length of Time: 1 class period
Standards Addressed

Priority:
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

Supporting:
- Alg2.SSE.A.3: Use properties of logarithms to solve equations or find equivalent expressions.
- Alg2.SSE.A.4: Understand why logarithmic scales are used, and use them to solve problems.
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.

Detailed Description/Instructions: Students will solve a variety of exponential growth applications. Population growth, radioactive decay, continuously compounded interest, and Newton’s Law of Cooling will be included.

Bloom’s Levels: Interpret; Webb’s DOK: 3
Engaging Scenario

Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.) Students will do research to find the retail price of a car 5 years ago and then find the current trade in value. The students will use the data to find the rate of depreciation of the car annually and monthly.

Students then research to find the retail price of a brand-new car. They will then have to find a rate they will be given for a loan to buy that car. Finally, the students will calculate the accumulated amount they will owe if they had not made any payments for 5 years.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponential Functions</td>
<td>Graphing Exponential Functions</td>
<td>Students will be giving several exponential functions of any base including $e$ to graph without the aid of a graphing utility. Students will graph these functions by using transformations and key characteristics common to all exponential functions such as domain, range, the horizontal asymptote, and key points.</td>
<td>1 class period</td>
</tr>
<tr>
<td>Logarithmic Function</td>
<td>Develop an Understanding of Logarithms</td>
<td>Students will convert logarithmic expressions into exponential functions with an unknown exponent. The students will then use the properties of exponents to solve for the missing exponent.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Logarithmic Function</td>
<td>Graph Logarithms</td>
<td>Students will use the graph of an exponential functions and the properties and symmetry of inverse functions to develop the graphs of logarithms of any base and state key characteristics such as domain, range, vertical asymptote, and key points. The students then will be asked to graph several logarithmic functions using transformations and then compare their graphs to a graphing utility and note the limitations of the graphing utility.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Logarithmic Function</td>
<td>Use Properties of Logarithms</td>
<td>Students will use the properties of logarithms to expand and condense expressions. To verify their work, students will be given functions and will graph the original functions and the expanded or condensed expression in the same window of a graphing utility to verify the functions are equivalent.</td>
<td>½ class period</td>
</tr>
<tr>
<td>Solve and Apply</td>
<td>Solving Exponential and Logarithmic Equations using a variety of methods</td>
<td>Students will be given exponential and logarithmic functions in a variety of formats. They will be asked to use their knowledge of the inverse relationship of the functions and exponentials and logarithmic properties to solve those equations.</td>
<td>2 class periods</td>
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<td>------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Solve and Apply</td>
<td>Exponential Growth and Decay</td>
<td>Students will solve a variety of exponential growth applications. Population growth, radioactive decay, continuously compounded interest, and Newton’s Law of Cooling will be included.</td>
<td>1 class period</td>
</tr>
</tbody>
</table>
# Unit 5: Conics and Systems of Equations

**Subject:** College Algebra B  
**Grade:** 10, 11, 12  
**Name of Unit:** Conics and Systems of Equations  
**Length of Unit:** 18 class periods  

**Overview of Unit:** Students will graph each conic section using its characteristics. Students will solve systems of equations including nonlinear systems. Students will apply systems of equations and inequalities to solve real world applications including linear programming.

**Priority Standards for unit:**
- Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.  
- Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

**Supporting Standards for unit:**
- Alg2.IF.A.2: Translate between equivalent forms of functions.  
- AL.9-12.F-CS.1 Create graphs of conic sections, including parabolas, hyperbolas, ellipses, circles, and degenerate conics, from second-degree equations.  
- AL.9-12.F-CS.1.a Formulate equations of conic sections from their determining characteristics.  
- ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.  
  - Write equations of parabolas in vertex form (PC-P.2)  
  - Write equations of circles in standard form (PC-P.5)  
  - Write equations of ellipses in standard form (PC-P.9)  
  - Write equations of hyperbolas in standard form (PC-P.12)  
  - Convert equations of conic sections from general to standard form (PC-P.13)

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb’s DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>systems of equations that may include non-linear equations and inequalities.</td>
<td>Create</td>
<td>Create</td>
<td>3</td>
</tr>
<tr>
<td>systems of equations that may include non-linear equations and inequalities.</td>
<td>Solve</td>
<td>Apply</td>
<td>2</td>
</tr>
</tbody>
</table>
key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.

| Identify | Understand | 2 |
| Interprett | Analyze | 3 |

**Essential Questions:**
1. Why is it important to be able to graph a conic section?
2. How solve a real-world problem that has several variables?
3. Why is it important to know several methods to solve systems of equations?
4. How do I write the solution to a system that has infinite many answers?
5. How can systems of inequalities be used to find an optimal solution?

**Enduring Understanding/Big Ideas:**
1. The graphs can be used to solve nonlinear systems.
2. Write a system that has as many equations as there are variables.
3. Some systems can only be solved graphically or only by substitution. Elimination is the only method that is used when we apply systems to matrices.
4. Write the answer using set-builder notation or parametrics.
5. They can be used in Linear Programming, to find what needs to be done to find the maximum and minimum values.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle</td>
<td>Parabola</td>
</tr>
<tr>
<td>Nonlinear</td>
<td>Ellipse</td>
</tr>
<tr>
<td></td>
<td>Hyperbola</td>
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<td></td>
<td>Vertex (Vertices)</td>
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<td></td>
<td>Focus (Foci)</td>
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<td>Directrix</td>
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<td>Axis (Major / Minor)</td>
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<td>Focal Diameter</td>
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<td></td>
<td>Asymptote</td>
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<td></td>
<td>System</td>
</tr>
<tr>
<td></td>
<td>Consistent</td>
</tr>
<tr>
<td></td>
<td>Inconsistent</td>
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<tr>
<td></td>
<td>Independent</td>
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<tr>
<td></td>
<td>Dependent</td>
</tr>
<tr>
<td>Resources for Vocabulary Development: Textbook</td>
<td></td>
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<tr>
<td>-----------------------------------------------</td>
<td></td>
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<tr>
<td>Parametric</td>
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<tr>
<td>Set-Builder</td>
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<td>Extrema</td>
<td></td>
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<tr>
<td>Optimization</td>
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<tr>
<td>Feasible Region</td>
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<tr>
<td>Objective Function</td>
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</tr>
</tbody>
</table>
Engaging Experience 1
Title: Conic Sections Centered about the Origin with the White Boards
Suggested Length of Time: 3 class periods (Circles/Ellipses - 1 day, Parabolas - 1 day, Hyperbolas - 1 day)
Standards Addressed
Priority:
• Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
Supporting:
• Alg2.IF.A.2: Translate between equivalent forms of functions.
• ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
• AL.9-12.F-CS.1 Create graphs of conic sections, including parabolas, hyperbolas, ellipses, circles, and degenerate conics, from second-degree Equations.
• AL.9-12.F-CS.1.a Formulate equations of conic sections from their determining characteristics.
Detailed Description/Instructions: Students will be given equations of conic sections in standard form and will then sketch their graphs and identity their key features. Students will be given the graph of a conic and then write its equation in standard form. When given the key features of a conic, students will write the equation and graph. They can use technology to verify their answers.
Bloom’s Levels: Understand
Webb’s DOK: 2

Engaging Experience 2
Title: Transforming Conic Sections
Suggested Length of Time: 3 class periods (Circles/Ellipses - 1 day, Parabolas - 1 day, Hyperbolas - 1 day). This experience will be done concurrently with engaging experience 1.
Standards Addressed
Priority:
• Alg2.IF.A.1: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
Supporting:

- Alg2.IF.A.2: Translate between equivalent forms of functions.
  AL.9-12.F-CS.1 Create graphs of conic sections, including parabolas, hyperbolas, ellipses, circles, and degenerate conics, from second-degree Equations.
- AL.9-12.F-CS.1.a Formulate equations of conic sections from their determining characteristics.

Detailed Description/Instructions: Students will be given translated conic sections in general and standard form and tasked with graphing those sections. If the section is in general form they will need to convert it is standard form by completing the square.

Bloom’s Levels: Analyze
Webb’s DOK: 3
Engaging Experience 1
Title: Writing Dependent Systems in Parametric Form
Suggested Length of Time: 1 class period
Standards Addressed
Priority:
• Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.
Supporting:
• Alg2.IF.A.2: Translate between equivalent forms of functions.
Detailed Description/Instructions: Students will solve linear systems and 3 variables that have infinite solutions. They will have to decide which type of dependent system they have been given and write the answer in the appropriate form, i.e. set-builder notation or parametric form.
Bloom’s Levels: Apply
Webb’s DOK: 2

Engaging Experience 2
Title: Extending Methods of Solving Linear Systems to Nonlinear on White Boards
Suggested Length of Time: 1 class periods
Standards Addressed
Priority:
• Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.
Detailed Description/Instructions: The student will apply substitution, elimination, and graphing to systems involving nonlinear equations.
Bloom’s Levels: Apply
Webb’s DOK: 2

Engaging Experience 3
Title: Graphically Solving Systems of Inequalities and Applying to Real World Situations
Suggested Length of Time: 2 blocks
Standards Addressed
Priority:
• Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.
Detailed Description/Instructions: Students will be presented with systems of inequalities involving linear and nonlinear inequalities and then use the process in linear programming.
Bloom’s Levels: Apply
Webb’s DOK: 2
Engaging Scenario

Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.)

Students will do the linear programming extension at the end of chapter 5 in the textbook to find optimal solutions. Students will need to show the system of linear inequalities and the vertices of the feasible region.
## Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conic Sections</td>
<td>Conic Sections Centered about the Origin with the White Boards</td>
<td>Students will be given equations of conic sections in standard form and will then sketch their graphs and identify their key features. Students will be given the graph of a conic and then write its equation in standard form. When given the key features of a conic, students will write the equation and graph.</td>
<td>3 class periods (Circles/Ellipses - 1 day, Parabolas - 1 day, Hyperbolas - 1 day)</td>
</tr>
<tr>
<td>Conic Sections</td>
<td>Transforming Conic Sections</td>
<td>Students will be given translated conic sections in general and standard form and tasked with graphing those sections. If the section is in general form, they will need to convert it to standard form by completing the square.</td>
<td>3 class periods (Circles/Ellipses - 1 day, Parabolas - 1 day, Hyperbolas - 1 day)</td>
</tr>
<tr>
<td>Systems of Equations</td>
<td>Writing Dependent Systems in Parametric Form</td>
<td>Students will solve linear systems and 3 variables that have infinite solutions. They will have to decide which type of dependent system they have been given and write the answer in the appropriate form, i.e. set-builder notation or parametric form.</td>
<td>1 class period</td>
</tr>
<tr>
<td>Systems of Equations</td>
<td>Extending Methods of solving Linear Systems to Nonlinear on White Boards</td>
<td>Students will be presented with systems of inequalities involving linear and nonlinear inequalities and then use the process in linear programming.</td>
<td>2 class periods</td>
</tr>
</tbody>
</table>
Unit 6: Systems and Matrices

Subject: College Algebra B
Grade: 10, 11, 12
Name of Unit: Systems and Matrices
Length of Unit: 8 class periods

Overview of Unit: Students will learn basic matrix operations to evaluate expressions and solve real world applications. Students will use matrices to solve linear systems including augmented matrices, inverse matrices, and Cramer’s Rule.

Priority Standards for unit:
- Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.

Supporting Standards for unit:
- N 406. Add two matrices that have whole number entries
- N 607. Use relations involving addition, subtraction, and scalar multiplication of vectors and of matrices
- N 706. Apply properties of matrices and properties of matrices as a number system
- ISTE-KNOWLEDGE COLLECTOR.3.D - build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
- ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

<table>
<thead>
<tr>
<th>Unwrapped Concepts</th>
<th>Unwrapped Skills</th>
<th>Bloom’s Taxonomy</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Students need to know)</td>
<td>(Students need to be able to do)</td>
<td>Levels</td>
<td>DOK</td>
</tr>
<tr>
<td>systems of equations that may include non-linear equations and inequalities.</td>
<td>Create</td>
<td>Create</td>
<td>3</td>
</tr>
<tr>
<td>systems of equations that may include non-linear equations and inequalities.</td>
<td>Solve</td>
<td>Apply</td>
<td>2</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How are matrices related to systems of linear equations?
2. Why are learning matrix solutions to systems beneficial?
3. How do I find and evaluate the determinant of a square matrix larger than a 2 x 2?
**Enduring Understanding/Big Ideas:**

1. Linear systems can be rewritten as an augmented matrix or a matrix equation.
2. Technology can be used to solve linear systems extremely quickly when written as matrix.
3. By using expansion by minors, a square can be broken into several 2x2 matrices.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented</td>
<td></td>
</tr>
<tr>
<td>Inverse</td>
<td></td>
</tr>
<tr>
<td>Row Echelon</td>
<td></td>
</tr>
<tr>
<td>Gaussian</td>
<td></td>
</tr>
<tr>
<td>Rows</td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td></td>
</tr>
<tr>
<td>Scalar</td>
<td></td>
</tr>
<tr>
<td>Order (Dimensions)</td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td></td>
</tr>
<tr>
<td>Determinant</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Cofactor</td>
<td></td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Topic 1: Matrices

Engaging Experience 1
Title: Real-World Problem with Matrix Operations
Suggested Length of Time: ½ class period (45 minutes)

Standards Addressed

Priority:

• Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.

Supporting:

• N 406. Add two matrices that have whole number entries
• N 607. Use relations involving addition, subtraction, and scalar multiplication of vectors and of matrices
• ISTE-KNOWLEDGE COLLECTOR.3.D - build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

Detailed Description/Instructions: Students will model real-world data using a system of equations and will perform the operations of addition, subtraction, and scalar multiplication. The website [https://meangreenmath.files.wordpress.com/2016/01/spacemath.png](https://meangreenmath.files.wordpress.com/2016/01/spacemath.png) contains a sample problem. Afterwards, students will model the same process using Microsoft Excel in order to make a connection between an abstract concept in mathematics and a concrete program that students use on a weekly basis.

Bloom’s Levels: Create
Webb’s DOK: 3

Engaging Experience 2
Title: Using Augmented Matrices to Solve Linear Systems
Suggested Length of Time: 2 class periods

Standards Addressed

Priority:

• Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.

Supporting:

• N 706. Apply properties of matrices and properties of matrices as a number system
• ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
Detailed Description/Instructions: Students will rewrite linear systems of equations as an augmented matrix and solve them using Gaussian and Gauss-Jordan Elimination. Students then will verify their answers by using a graphing calculator to put the matrix in Reduced Row Echelon Form.

Bloom’s Levels: Apply
Webb’s DOK: 2

Engaging Experience 3
Title: Using a Matrix Equation to Solve Linear Systems
Suggested Length of Time: 2 class periods
Standards Addressed

Priority:
- Alg2.REI.B.1: Create and solve systems of equations that may include non-linear equations and inequalities.

Supporting:
- N 706. Apply properties of matrices and properties of matrices as a number system
- ISTE-COMPUTATIONAL THINKER.5.A - formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.

Detailed Description/Instructions: Students will rewrite linear systems of equations as a matrix equation and solve them using an Inverse Matrix and Cramer’s Rule. Students will use a graphing utility to find the inverse and determinants of larger systems.

Bloom’s Levels: Apply
Webb’s DOK: 2
Engaging Scenario (An Engaging Scenario is a culminating activity that includes the following components: situation, challenge, specific roles, audience, product or performance.) Students will be handed a bag consisting of 4 types of coins and be told the total amount of money and number of coins. They will also be given two pieces of information that will relate the amount of the different types of coins. Students will use this information to determine how many of each type of coin is in the bag. Students will need to produce the systems of equations and matrices but may use technology to solve. To confirm their results, the students will then open the bag and count the coins.
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<td>Using Augmented Matrices to Solve Linear Systems</td>
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<tr>
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<td>Students will rewrite linear systems of equations as a matrix equation and solve them using an Inverse Matrix and Cramer’s Rule. Students will use a graphing utility to find the inverse and determinants of larger systems.</td>
<td>2 class periods</td>
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</table>
Unit of Study Terminology

Appendices: All Appendices and supporting material can be found in this course’s shell course in the District’s Learning Management System.

Assessment Leveling Guide: A tool to use when writing assessments in order to maintain the appropriate level of rigor that matches the standard.

Big Ideas/Enduring Understandings: Foundational understandings teachers want students to be able to discover and state in their own words by the end of the unit of study. These are answers to the essential questions.

Engaging Experience: Each topic is broken into a list of engaging experiences for students. These experiences are aligned to priority and supporting standards, thus stating what students should be able to do. An example of an engaging experience is provided in the description, but a teacher has the autonomy to substitute one of their own that aligns to the level of rigor stated in the standards.

Engaging Scenario: This is a culminating activity in which students are given a role, situation, challenge, audience, and a product or performance is specified. Each unit contains an example of an engaging scenario, but a teacher has the ability to substitute with the same intent in mind.

Essential Questions: Engaging, open-ended questions that teachers can use to engage students in the learning.

Priority Standards: What every student should know and be able to do. These were chosen because of their necessity for success in the next course, the state assessment, and life.

Supporting Standards: Additional standards that support the learning within the unit.

Topic: These are the main teaching points for the unit. Units can have anywhere from one topic to many, depending on the depth of the unit.

Unit of Study: Series of learning experiences/related assessments based on designated priority standards and related supporting standards.

Unit Vocabulary: Words students will encounter within the unit that are essential to understanding. Academic Cross-Curricular words (also called Tier 2 words) are those that can be found in multiple content areas, not just this one. Content/Domain Specific vocabulary words are those found specifically within the content.