High School College Algebra A Curriculum

Course Description: The class consists of Math 110, Intermediate Algebra from the Metropolitan Community College for 3 hours college credit. The catalog description for Math 110 is a study of functions and their graphs, systems of linear equations, application problems, linear and quadratic inequalities, absolute value equations and inequalities, rational exponents, radicals, quadratic equations, ratios and proportions.

Scope and Sequence:

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<th>Timeframe</th>
<th>Unit</th>
<th>Instructional Topics</th>
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<td>14 class periods</td>
<td>1-Variable Equations and Inequalities</td>
<td>Topic 1: Set Theory&lt;br&gt;Topic 2: Properties of Real Numbers&lt;br&gt;Topic 3: Linear Equations&lt;br&gt;Topic 4: Inequalities</td>
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<tr>
<td>8 class periods</td>
<td>2-Variable Equations and Inequalities</td>
<td>Topic 1: Coordinate Geometry&lt;br&gt;Topic 2: Linear Functions&lt;br&gt;Topic 3: Functions</td>
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<tr>
<td>8 class periods</td>
<td>Systems</td>
<td>Topic 1: Solve and Apply&lt;br&gt;Topic 2: Matrices</td>
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<td>Exponents and Polynomials</td>
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</tr>
<tr>
<td>11 class periods</td>
<td>Rationals</td>
<td>Topic 1: Simplify Rational Expressions&lt;br&gt;Topic 2: Solve and Apply</td>
</tr>
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<td>9 class periods</td>
<td>Radicals</td>
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</tr>
</tbody>
</table>
Unit 1: 1 Variable Equations and Inequalities

Subject: College Algebra A
Grade: 10, 11, 12
Name of Unit: 1 Variable Equations and Inequalities
Length of Unit: 14 class periods
Overview of Unit: In this unit, students will solve and model with linear equations and inequalities, utilize the definitions of real numbers and their properties, and properly communicate solutions using the concepts of set theory.

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

Supporting Standards for unit:
- 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>
</tbody>
</table>

Essential Questions:
1. How do you use interval notation to communicate solutions?
2. How do you use the properties of real numbers to evaluate expressions and solve equations?
3. How is order of operations used to isolate a variable in an equation?
4. How do you solve compound inequalities?

Enduring Understanding/Big Ideas:
1. Write solutions from the smallest endpoint to largest endpoint using parentheses or brackets correctly.
2. They are used to make computations easier and quicker than relying only on following the order of operations.
3. Variables are isolated by applying the order of operations backwards with inverses.
4. They are solved by determining if we have an and/or statement and communicating the solution using correct notation.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate</td>
<td>Inequality</td>
</tr>
<tr>
<td>Intersection</td>
<td>Absolute value</td>
</tr>
<tr>
<td>Union</td>
<td>Algebraic expression</td>
</tr>
<tr>
<td></td>
<td>Numeric Expression</td>
</tr>
<tr>
<td></td>
<td>Additive inverse</td>
</tr>
<tr>
<td></td>
<td>Multiplicative Inverse</td>
</tr>
<tr>
<td></td>
<td>Irrational</td>
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<tr>
<td></td>
<td>Rational</td>
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<tr>
<td></td>
<td>Integer</td>
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<td></td>
<td>Whole</td>
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<td></td>
<td>Natural</td>
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<tr>
<td></td>
<td>Expression vs. Equation</td>
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<tr>
<td></td>
<td>Interval Notation</td>
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<td></td>
<td>Sets</td>
</tr>
<tr>
<td></td>
<td>Element</td>
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<tr>
<td></td>
<td>Subset</td>
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</tbody>
</table>

**Resources for Vocabulary Development:** textbook
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: Properties with Algebra Tiles
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: As this is the first time that students will have seen the distributive property using variables in College Algebra, we will distribute and divide variable expressions using algebra tiles. This will strengthen various properties and provide a lead-in to future lessons.

Bloom’s Levels: Create and Apply

Webb’s DOK: 3, 2
Engaging Experience 1
Title: Reverse Procedures to demonstrate isolation
Suggested Length of Time: 10-15 minutes
Standards Addressed

Priority:

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

Detailed Description/Instructions: Students will pair up, one will write out a procedure (i.e., the process of putting a gas nozzle in a car), the other student will write the reverse procedure (i.e., taking the nozzle out). They will then apply this to a linear equation using the reverse order of operations.

Bloom’s Levels: Create and Apply

Webb’s DOK: 3, 2
Engaging Experience 1
Title: Inequalities from a graphical/numerical perspective
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: Students will be given various problems that provide a more meaningful approach to solving inequalities. These examples will include types that have no solution, encompass all real numbers, solutions that contain a set and one of its subsets, and other “non-traditional” problems that lead to students thinking critically about the definitions of inequalities, and statements, and or statements.
Bloom’s Levels: Create and Apply
Webb’s DOK: 3, 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.)

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.
## 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>Set Theory</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>Properties of Real Numbers</td>
<td>Properties With Algebra Tiles</td>
<td>As this is the first time that students will have seen the distributive property using variables in College Algebra, we will distribute and divide variable expressions using algebra tiles. This will strengthen various properties and provide a lead-in to future lessons.</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Linear Equations</td>
<td>Reverse Procedures to demonstrate isolation</td>
<td>Students will pair up, one will write out a procedure (i.e., the process of putting a gas nozzle in a car), the other student will write the reverse procedure (i.e., taking the nozzle out). They will then apply this to a linear equation using the reverse order of operations.</td>
<td>10-15 minutes</td>
</tr>
<tr>
<td>Inequalities</td>
<td>Inequalities from a graphical/numerical perspective</td>
<td>Students will be given various problems that provide a more meaningful approach to solving inequalities. These examples will include types that have no solution, encompass all real numbers, solutions that contain a set and one of its subsets, and other “non-traditional” problems that lead to students thinking critically about the definitions of inequalities, and statements, and or statements.</td>
<td>15 minutes</td>
</tr>
</tbody>
</table>
Unit 2: 2 Variable Equations and Inequalities

Subject: College Algebra A
Grade: 10, 11, 12
Name of Unit: 2 Variable Equations and Inequalities
Length of Unit: 8 class periods
Overview of Unit: In this unit students will graph and write linear equations. They will work with equations in standard form, point-slope form, and slope-intercept form. In addition, they will find equations that are parallel and perpendicular.

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.

Supporting Standards for unit:
- 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.
- 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-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.

<table>
<thead>
<tr>
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<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>key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems</td>
<td>Identify</td>
<td>Remember</td>
<td>1</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 is the slope of two lines related to their graphs?
2. How do we use given information to write the equation or construct a graph of a linear equation?
3. How is the graph of a linear equation different than the graph of a linear inequality?
4. How are relations and functions similar and different?

Enduring Understanding/Big Ideas:
1. Find the slope of parallel and perpendicular lines and understand the relationship between the two.
2. Write and graph linear equations in Point-Slope, Standard, and Slope-Intercept forms.
3. Linear equations contain the set of all solutions to an equation while linear inequalities contain the set of all solutions that satisfy an inequality.
4. Functions are relations that have a unique $y$-value for each $x$-value.

Unit Vocabulary:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Linear</td>
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<tr>
<td>Slope</td>
<td>Coordinate plane</td>
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<tr>
<td>Intercept</td>
<td>Parallel</td>
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<td>Rate of Change</td>
<td>Perpendicular</td>
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<tr>
<td>Scatterplot</td>
<td>Point-Slope Form</td>
</tr>
<tr>
<td>Intersection</td>
<td>Slope-Intercept Form</td>
</tr>
<tr>
<td>Equation</td>
<td>Standard Form</td>
</tr>
<tr>
<td>Independent Variable</td>
<td>Inequality</td>
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<tr>
<td>Dependent Variable</td>
<td>Function</td>
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<tr>
<td></td>
<td>Relation</td>
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<tr>
<td></td>
<td>Reciprocal</td>
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</tbody>
</table>

Resources for Vocabulary Development: textbook
Topic 1: Coordinate Geometry

Engaging Experience 1
Title: Deriving formulas for distance and midpoint using the Pythagorean Theorem
Suggested Length of Time: 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.

Supporting:
- Alg2.IF.A.2: Translate between equivalent forms of functions.

Detailed Description/Instructions: Instead of giving students the formulas they will need for distance and midpoint, we will prove them using the Pythagorean Theorem, which students remember from Geometry.

Bloom’s Levels: Analyze
Webb’s DOK: 3
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.

Supporting:
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.

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 Experience 1
Title: Marbleslides Lines in Desmos
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.3 Measure, compute, describe, and interpret rates of change of quantities embedded in multiple representations.
- 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 follow prompts in a Desmos activity that allows them to construct lines that intersect various “stars.” Students will need to create multiple functions to make the scenario work and also keep mindful about domain restrictions, although they do not need to be fluent with the concept of domain at this point in time.

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.) Students will complete a linear regression project. Students will analyze the linear relationship (correlation) between two variables of their choosing. The project consists of researching data, analysis, and presenting the data and analysis in a formal report.
# 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>Coordinate Geometry</td>
<td>Deriving formulas for distance and midpoint using the Pythagorean Theorem</td>
<td>Instead of giving students the formulas they will need for distance and midpoint, we will prove them using the Pythagorean Theorem, which students remember from Geometry.</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Linear 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>
<tr>
<td>Functions</td>
<td>Marbleslides Lines in Desmos</td>
<td>Students will follow prompts in a Desmos activity that allows them to construct lines that intersect various “stars.” Students will need to create multiple functions to make the scenario work and also keep mindful about domain restrictions, although they do not need to be fluent with the concept of domain at this point in time.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 3: Systems

Subject: College Algebra
Grade: 10, 11, 12
Name of Unit: Systems
Length of Unit: 3 class periods
Overview of Unit: In this unit students will solve systems of linear equations in two and three variables. Students will also use matrices to solve a system of linear equations.

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:
- 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>
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<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>
<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 we solve a linear system of two and three variables?
2. What are the solution types of a linear system, and how are they used to classify the system?
3. What is a matrix, and why do we use it to represent a linear system?

**Enduring Understanding/Big Ideas:**
1. Use various strategies including graphing, substitution, and linear combination
2. The solutions can be independent and consistent, dependent and consistent, or inconsistent, and they are used to describe any linear system.
3. A matrix is an array of numbers that can be used to represent and solve a linear system.

**Unit Vocabulary:**

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<th>Academic Cross-Curricular Words</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Substitution</td>
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<td></td>
<td>Linear Combination</td>
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<td></td>
<td>Consistent</td>
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<td></td>
<td>Inconsistent</td>
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<td></td>
<td>Independent</td>
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<td></td>
<td>Dependent</td>
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<td></td>
<td>Determinant</td>
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<td></td>
<td>Scalar Multiplication</td>
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<td></td>
<td>Commutativity</td>
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<td></td>
<td>Cramer’s Rule</td>
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</tbody>
</table>

**Resources for Vocabulary Development:** textbook
Topic 1: Solve and Apply

Engaging Experience 1

Title: The Tortoise and Hare Activity

Suggested Length of Time: 60 minutes

Standards Addressed

Priority:

- 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:

- 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: The Tortoise and the Hare finally have their long-awaited rematch. The Tortoise gets a 1,000-foot lead and runs at 9 inches per second. The Hare begins at the starting line and runs at a rate of 6 feet per second. There is also a rat in this race. The Rat starts 1,200 feet ahead of the Hare and runs back towards the starting line at a rate of 2 feet per second.

In this problem, students extract data from a story in order to write, manipulate, and graph systems of equations. It offers students a context to understand the relationships among data, equations, graphs and solutions.

Bloom’s Levels: Create and Apply

Webb’s DOK: 3, 2
Engaging Experience 1

Title: Matrix Operations Cube Activity

Suggested Length of Time: 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 create (or will be given) two cubes. On one will be various matrices with differing dimensions. On the other will be different operations. Depending on the roll, students will need to perform specific operations on the given matrices.

Bloom’s Levels: Understand

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 research two cars, given specific guidelines. One is an older model, cheap, sports car that gets poor gas mileage, the other a newer more economical, more expensive vehicle. Students will research the cost and gas mileage. They will then model this information with linear equations, graph and determine at what point in time the cost of the two vehicles would intersect. For the final product they would then have to summarize by determining which car would be the best and give mathematically supported reasons.
## Summary of Engaging Learning Experiences for Topics

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<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve and Apply</td>
<td>The Tortoise and Hare Activity</td>
<td>The Tortoise and the Hare finally have their long-awaited rematch. The Tortoise gets a 1,000-foot lead and runs at 9 inches per second. The Hare begins at the starting line and runs at a rate of 6 feet per second. There is also a rat in this race. The Rat starts 1,200 feet ahead of the Hare and runs back towards the starting line at a rate of 2 feet per second.</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Matrices</td>
<td>Matrix Operations Cube Activity</td>
<td>Students will create (or will be given) two cubes. On one will be various matrices with differing dimensions. On the other will be different operations. Depending on the roll, students will need to perform specific operations on the given matrices.</td>
<td>20 minutes</td>
</tr>
</tbody>
</table>
Unit 4: Exponents and Polynomials

Subject: College Algebra A
Grade: 10, 11, 12
Name of Unit: Exponents and Polynomials
Length of Unit: 11 class periods
Overview of Unit: In this unit students will simplify expressions using the rules of exponents. Students will also factor and solve quadratic (and quadratic type) equations.

Priority Standards for unit:
- Alg1.SSE.A.2: Analyze the structure of polynomials to create equivalent expressions or equations.

Supporting Standards for unit:
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.
- ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
- ISTE-INNOVATIVE DESIGNER.4.B - select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

<table>
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<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>the structure of polynomials to create equivalent expressions or equations.</td>
<td>Analyze</td>
<td>Analyze</td>
<td>2</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How do you simplify expressions using exponents?
2. How do you write a polynomial in completely factored form?
3. What is the zero-factor property and how do you use it to solve polynomial equations?

Enduring Understanding/Big Ideas:
1. Use the properties of exponents.
2. Use various strategies of factoring including: GCF, difference of squares, perfect square trinomials, trinomials, and sum/difference of cubes.
3. When the product of two real numbers is zero, at least one of them is zero. This can be used to solve for each factor.

**Unit Vocabulary:**

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<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties/rule/laws</td>
<td>Simplest form</td>
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<tr>
<td>Coefficient</td>
<td>Factor</td>
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<td>Polynomial</td>
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<td>Base</td>
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<td>Degree</td>
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<td>Binomial</td>
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<td>Trinomial</td>
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<td>Perfect Square Trinomial</td>
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<td></td>
<td>Greatest Common Factor</td>
</tr>
<tr>
<td></td>
<td>FOIL</td>
</tr>
<tr>
<td></td>
<td>Prime</td>
</tr>
<tr>
<td></td>
<td>Zero-Product Property</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** textbook
Topic 1: Simplify Polynomials

Engaging Experience 1
Title: Polynomial Operation Mix-And-Match Activity
Suggested Length of Time: 30 minutes
Standards Addressed

Priority:
- Alg1.SSE.A.2: Analyze the structure of polynomials to create equivalent expressions or equations.

Supporting:
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.

Detailed Description/Instructions: Students will be given a note card with a polynomial expression on it, and they will be expected to analyze the degree, number of terms, and leading coefficient. In the first round, students will organize themselves into groups by degree, answering questions involving adding and subtracting polynomials. In the second round, students will organize themselves by number of terms and will multiply polynomials. In the third round, students will find groups based on the leading coefficient and will simplify expressions in quadratic form and using division.

Bloom’s Levels: Analyze
Webb’s DOK: 2
Topic 2: Factoring

Engaging Experience 1

Title: Factoring Using Algebra Tiles

Suggested Length of Time: 15 minutes

Standards Addressed

Priority:

• Alg1.SSE.A.2: Analyze the structure of polynomials to create equivalent expressions or equations.

Supporting:

• Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.

• ISTE-COMPUTATIONAL THINKER.5.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Detailed Description/Instructions: Students will be given the task of creating a rectangle given algebra tiles or creating their own tiles using Smart Notebook. For example, the equation $x^2+8x+15$ would be represented by one blue square, 8 green “rows of $x$” and 15 green single tiles. Using those tiles, students will attempt to create a rectangle. In this activity, students will see the relationship between factoring and FOILing and start to learn what it means to both be a perfect square trinomial and complete the square.

Bloom’s Levels: Analyze

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 pair up to design a swimming pool complex using specific guidelines and a budget. Students will be required to multiply polynomials, factor, and solve quadratics by factoring in a real-world scenario.
## 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>Simplify Polynomials</td>
<td>Polynomial Operation Mix-And-Match Activity</td>
<td>Students will be given a note card with a polynomial expression on it, and they will be expected to analyze the degree, number of terms, and leading coefficient. In the first round, students will organize themselves into groups by degree, answering questions involving adding and subtracting polynomials. In the second round, students will organize themselves by number of terms and will multiply polynomials. In the third round, students will find groups based on the leading coefficient and will simplify expressions in quadratic form and using division.</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Factoring</td>
<td>Factoring Using Algebra Tiles</td>
<td>Students will be given the task of creating a rectangle given algebra tiles or creating their own tiles using Smart Notebook. For example, the equation x²+8x+15 would be represented by one blue square, 8 green “rows of x” and 15 green single tiles. Using those tiles, students will attempt to create a rectangle. In this activity, students will see the relationship between factoring and FOILing and start to learn what it means to both be a perfect square trinomial and complete the square.</td>
<td>15 minutes</td>
</tr>
</tbody>
</table>
## Unit 5: Rationals

**Subject:** College Algebra A  
**Grade:** 10, 11, 12  
**Name of Unit:** Rationals  
**Length of Unit:** 6 class periods  
**Overview of Unit:** In this unit students will simplify, add, subtract, multiply, and divide rational functions. Students will also solve rational equations.

### Priority Standards for unit:
- Alg2.REI.A.2: Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.  
- Alg2.APR.A.4: Add, subtract, multiply and divide rational expressions.

### Supporting Standards for unit:
- Alg2.APR.A.2: Understand the Remainder Theorem and use it to solve problems.  
- Alg2.APR.A.3: Find the least common multiple of two or more polynomials.  
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.  
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

<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>rational equations where numerators and denominators are polynomials and where extraneous solutions may result</td>
<td>Solve</td>
<td>Analyze</td>
<td>3</td>
</tr>
<tr>
<td>rational expressions</td>
<td>Add, subtract, multiply and divide</td>
<td>Apply</td>
<td>1</td>
</tr>
</tbody>
</table>

### Essential Questions:
1. How do you simplify rational expressions?  
2. Why is the domain affected by rational functions?  
3. Why are the domain restrictions in rational equations important?  
4. How do you solve rational equations and use them to model real-world applications?

### Enduring Understanding/Big Ideas:
1. Add, subtract, multiply, and divide using the cancellation property and common denominators.
2. A domain restriction occurs when there are values for $x$ that make the function undefined. Rational functions have undefined values because they make the denominator equal to zero.

3. Domain restrictions create potentially extraneous solutions.

4. Find the domain restrictions, multiply by the LCD, and solve for the variable. Check for extraneous solutions by analyzing the domain restrictions.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolate variable</td>
<td>Domain restrictions</td>
</tr>
<tr>
<td></td>
<td>Complex fractions</td>
</tr>
<tr>
<td></td>
<td>Least Common Denominator</td>
</tr>
<tr>
<td></td>
<td>Least Common Divisor</td>
</tr>
<tr>
<td></td>
<td>Extraneuos</td>
</tr>
<tr>
<td></td>
<td>Cancellation Property</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** textbook
Engaging Experience 1
Title: Quadrant Partners Activity
Suggested Length of Time: 20 minutes
Standards Addressed

Priority:
- Alg2.APR.A.4: Add, subtract, multiply and divide rational expressions.

Supporting:
- Alg2.APR.A.3: Find the least common multiple of two or more polynomials.
- ISTE-EMPOWERED LEARNER1.C - use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.

Detailed Description/Instructions: Students will find four partners around the room (a different individual for each of their quadrants). In their partnership, students will work together to solve a problem put the solution in an online document such as the collaboration space on One Note, and the teacher will ensure each group has the correct solution, addressing any misconceptions as they arise. This process will be repeated for each of the four quadrant partners.

Bloom’s Levels: Apply
Webb’s DOK: 1

Engaging Experience 2
Title: RallyCoach Activity
Suggested Length of Time: 20 minutes
Standards Addressed

Priority:
- Alg2.APR.A.4: Add, subtract, multiply and divide rational expressions.

Supporting:
- Alg2.APR.A.3: Find the least common multiple of two or more polynomials.

Detailed Description/Instructions: Students will find a partner and complete four problems. Two of the problems will be completed by Partner A, with Partner B checking for accuracy. Similarly, two problems will be completed by Partner B, with Partner A checking for accuracy. This accountability piece will hold each partner accountable, even if he or she is not currently working a problem.

Bloom’s Levels: Apply
Webb’s DOK: 1
Topic 2: Solve and Apply

Engaging Experience 1
Title: Round Table Activity
Suggested Length of Time: 45 minutes
Standards Addressed

Priority:

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

Supporting:

- Alg2.APR.A.2: Understand the Remainder Theorem and use it to solve Problems.
- ISTE-GLOBAL COLLABORATOR.7.C - contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

Detailed Description/Instructions: Students will be placed in groups of four by the teacher and presented with a problem involving modeling a real-world scenario using rational equations. Each student will have one of four unique roles. He or she will either define the variables/provide a diagram, set up the equation, solve the equation, or effectively communicate the solution to the problem. This process will be repeated four times so that each team member can experience each role in the group, with the teacher checking the solution before providing the next problem to each group.

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.) Students will be given the choice of a task (work out simple math problems, shoot baskets, stack blocks, etc.). Students will then individually complete their task and record the time it took for them to complete given task. Students will then pair up and, based on their individual times, calculate how long it would take them to complete the task together. Students will then complete the task together; record the time it took for them to complete the given task together and compare their results.
<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>Simplify Rational</td>
<td>Quadrant Partners Activity</td>
<td>Students will find four partners around the room (a different individual for each of their quadrants). In their partnership, students will work together to solve a problem put the solution in an online document such as the collaboration space on One Note, and the teacher will ensure each group has the correct solution, addressing any misconceptions as they arise. This process will be repeated for each of the four quadrant partners.</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Expressions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simplify Rational</td>
<td>RallyCoach Activity</td>
<td>Students will find a partner and complete four problems. Two of the problems will be completed by Partner A, with Partner B checking for accuracy. Similarly, two problems will be completed by Partner B, with Partner A checking for accuracy. This accountability piece will hold each partner accountable, even if he or she is not currently working a problem.</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Expressions</td>
<td></td>
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</tbody>
</table>
Unit 6: Radicals

**Subject:** College Algebra A
**Grade:** 10, 11, 12
**Name of Unit:** Radicals
**Length of Unit:** 9 class periods

**Overview of Unit:** In this unit students will work with radicals and rational exponents. They will also be introduced to complex numbers and operations with complex numbers.

**Priority Standards for unit:**
- Alg2.NQ.A.1: Extend the system of powers and roots to include rational exponents.
- Alg2.NQ.A.2: Create and recognize equivalent expressions involving radical and exponential forms of expressions.
- Alg2.NQ.A.3: Add, subtract, multiply and divide radical expressions.
- Alg2.NQ.A.4: Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.

**Supporting Standards for unit:**
- Alg2.NQ.B.1: Represent complex numbers.
- Alg2.NQ.B.2: Add, subtract, multiply and divide complex numbers.
- 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.
- ISTE-KNOWLEDGE COLLECTOR.3.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
- 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.

<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 system of powers and roots to include rational exponents.</td>
<td>Extend</td>
<td>Understand</td>
<td>4</td>
</tr>
<tr>
<td>equivalent expressions involving radical and exponential forms of expressions.</td>
<td>Create</td>
<td>Create</td>
<td>1</td>
</tr>
<tr>
<td>equivalent expressions involving radical and exponential forms of expressions.</td>
<td>Recognize</td>
<td>Create</td>
<td>2</td>
</tr>
</tbody>
</table>
radical expressions. | Add, subtract, multiply, and divide | Apply | 1
--- | --- | --- | ---
equations involving rational exponents and/or radicals | Solve | Apply | 2
situations where extraneous solutions may result | Identify | Analyze | 3

**Essential Questions:**
1. How do you simplify radicals?
2. How do you combine radicals using the basic operations?
3. How do you rewrite radicals using rational exponents?
4. How do you solve equations involving radicals?
5. What is a complex number and how do you simplify complex numbers?

**Enduring Understanding/Big Ideas:**
1. You can simplify radicals by writing a radical in simplest form including the proper use of absolute values.
2. Adding, subtracting, multiplying and dividing radicals, including rationalizing the denominator.
3. Rewriting a radical using rational exponents and rewriting a number with a rational exponent as a radical.
4. Isolate the variable by applying the order of operations backwards and checking for extraneous solutions.
5. Define a complex number and do the basic mathematical operations with complex numbers.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radical</td>
<td>Radical</td>
</tr>
<tr>
<td>Rational Exponents</td>
<td>Rational Exponents</td>
</tr>
<tr>
<td>Rationalize</td>
<td>Rationalize</td>
</tr>
<tr>
<td>Extraneous</td>
<td>Extraneous</td>
</tr>
<tr>
<td>Complex Numbers</td>
<td>Complex Numbers</td>
</tr>
<tr>
<td>Conjugate</td>
<td>Conjugate</td>
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<tr>
<td>Radicand</td>
<td>Radicand</td>
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<tr>
<td>Index</td>
<td>Index</td>
</tr>
<tr>
<td>Root</td>
<td>Root</td>
</tr>
<tr>
<td>Square Root</td>
<td>Square Root</td>
</tr>
</tbody>
</table>

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

Engaging Experience 1
Title: Guided Practice
Suggested Length of Time: 15-30 minutes
Standards Addressed

Priority:
- ALG2.NQ.A.1: Extend the system of powers and roots to include rational exponents.
- ALG2.NQ.A.2: Create and recognize equivalent expressions involving radical and exponential forms of expressions.

Supporting:
- Alg2.IF.A.2: Translate between equivalent forms of functions.

Detailed Description/Instructions: Students will review the process of simplifying radicals by performing various examples of simplifying radicals on a personal whiteboard (or using their laptop as a whiteboard).

Bloom’s Levels: Understand, Create, Create

Webb’s DOK: 4, 1, 2
Engaging Experience 1
Title: Who is Right?
Suggested Length of Time: 15-20 minutes
Standards Addressed

**Priority:**
- Alg2.NQ.A.4: Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.

**Supporting:**
- NMP.FF.2 Use multiple representations of functions to interpret and describe how two quantities change together.
- ISTE - KNOWLEDGE COLLECTOR.3.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.

**Detailed Description/Instructions:** Give students a problem (sqrt of x = -3). Show two students solutions - Carlos says the answer is 9 because you are supposed to square both sides, Andrea says there is no solution, have students discuss who is right and why - be sure to emphasize the importance of checking for extraneous solutions. Then move on to a more difficult example (6 = x + sqrt(x)). Have students solve them and compare their solutions with a partner.

**Bloom’s Levels:** Apply

**Webb’s DOK:** 1
Engaging Experience 1
Title: Who is Right?
Suggested Length of Time: 10-15 minutes
Standards Addressed

Priority:
- Alg2.NQ.A.3: Add, subtract, multiply and divide radical expressions

Supporting:
- Alg2.NQ.B.1: Represent complex numbers.
- Alg2.NQ.B.2: Add, subtract, multiply and divide complex numbers.
- ISTE-KNOWLEDGE COLLECTOR.3.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.

Detailed Description/Instructions: After reviewing the definition of a complex number present students with the following problem: sqrt(-4) x sqrt(-4) = 4. Discuss as a class or in small groups whether this is correct or incorrect and why. Then go on to explain, if necessary, that if sqrt(3) x sqrt(3) = 3, shouldn’t the sqrt(-4) x sqrt(-4) = -4? Using complex numbers show why this works.

Bloom’s Levels: Apply
Webb’s DOK: 1
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 access the graphing calculator features on Desmos. They will input various nth roots of the nth powers to notice patterns. Through discussion and collaboration, we will determine when the graphs are strictly located above the x-axis. Then, we will reverse the process to see when extraneous solutions are needed.
## 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>Simplifying Radicals</td>
<td>Guided Practice</td>
<td>Students will review the process of simplifying radicals by performing various examples of simplifying radicals on a personal whiteboard (or using their laptop as a whiteboard).</td>
<td>15-30 minutes</td>
</tr>
<tr>
<td>Solving Radical Equations</td>
<td>Who is Right?</td>
<td>Give students a problem (sqrt of x = -3). Show two students solutions - Carlos says the answer is 9 because you are supposed to square both sides, Andrea says there is no solution, have students discuss who is right and why - be sure to emphasize the importance of checking for extraneous solutions. Then move on to a more difficult example (6 = x + sqrt(x)). Have students solve them and compare their solutions with a partner.</td>
<td>15-20 minutes</td>
</tr>
<tr>
<td>Complex Numbers</td>
<td>Who is Right?</td>
<td>After reviewing the definition of a complex number present students with the following problem: sqrt(-4) x sqrt(-4) = 4. Discuss as a class or in small groups whether this is correct or incorrect and why. Then go on to explain, if necessary, that if sqrt(3) x sqrt(3) = 3, shouldn’t the sqrt(-4) x sqrt(-4) = -4? Using complex numbers show why this works.</td>
<td>10-15 minutes</td>
</tr>
</tbody>
</table>
Unit 7: Quadratics

Subject: College Algebra A
Grade: 10, 11, 12
Name of Unit: Quadratics
Length of Unit: 6 class periods

Overview of Unit: In this unit students will solve quadratic (and quadratic type) functions, analyze the graph of a quadratic function and solve quadratic inequalities.

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.

Supporting Standards for unit:
- Alg2.IF.A.2: Translate between equivalent forms of 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-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.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.
- Alg1.SSE.A.3: Choose and produce equivalent forms of a quadratic expression or equations to reveal and explain properties.
  - Find the zeros of a quadratic function by rewriting it in factored form.
  - Find the maximum or minimum value of a quadratic function by completing the square.

<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>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</td>
<td>Interpret</td>
<td>Analyze</td>
<td>3</td>
</tr>
</tbody>
</table>
tables and with algebraic symbolism to solve problems.

**Essential Questions:**
1. How do you solve a quadratic function?
2. How do you use the graph of a quadratic function to find the maximum/minimum values?
3. How do you solve a quadratic inequality?
4. How do you write a quadratic equation from given roots?
5. How do you solve other polynomials in quadratic form?

**Enduring Understanding/Big Ideas:**
1. Solve a quadratic function using a variety of techniques including factoring, the quadratic formula and completing the square.
2. Use the vertex to graph a quadratic function and find the maximum or minimum value of that function.
3. Solve a quadratic inequality by graphing and using a table and then communicating the solution using interval notation.
4. Work backwards to write a quadratic equation from given roots.
5. Solving quadratic type equations using substitution.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roots</td>
<td>Quadratic</td>
</tr>
<tr>
<td>Optimization (Maximum/Minimum)</td>
<td>Discriminant</td>
</tr>
<tr>
<td>Intercepts</td>
<td>Quadratic inequalities</td>
</tr>
<tr>
<td></td>
<td>Factoring</td>
</tr>
<tr>
<td></td>
<td>Parabola</td>
</tr>
<tr>
<td></td>
<td>Vertex</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
Engaging Experience 1

Title: Generate the quadratic formula by completing the square

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.

Supporting:

- Alg2.IF.A.2: Translate between equivalent forms of functions
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.
- Alg1.SSE.A.3: Choose and produce equivalent forms of a quadratic expression or equations to reveal and explain properties.

Find the zeros of a quadratic function by rewriting it in factored form.

Find the maximum or minimum value of a quadratic function by completing the square.

- 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 can complete this on a white board: Have the students write out a quadratic equation in standard form (with values for a, b, and c where a does not equal 1). Have them solve this equation by completing the square. Now have them write out $ax^2 + bx + c = 0$ and solve this by completing the square. If they do it correctly, they should generate the quadratic formula.

Bloom’s Levels: Understand, Analyze

Webb’s DOK: 2, 3
**Topic 2: Solving and Applying**

**Engaging Experience 1**

**Title:** Making a connection

**Suggested Length of Time:** 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.

*Supporting:*

- 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.

**Detailed Description/Instructions:** Give the students a quadratic inequality and have them graph it on their graphing calculator (or use Desmos), demonstrate the solution using interval notation. Give them a few more examples with a variety of solution types and a variety of types of quadratic functions (some in factored form). Discuss what conclusions can be made about the solutions (they should notice that the critical points come from the roots of the quadratic equations). Now demonstrate the test-point method as another way of solving a quadratic inequality without graphing on a coordinate plane.

**Bloom’s Levels:** Understand, Analyze

**Webb’s DOK:** 2, 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.)

“Match My Curve!” activity on Desmos. In this activity, students develop their understanding of standard, factored, and vertex forms of quadratic functions by matching parabolas (as closely as they can) to curves in images from the real world.
<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>Generate the quadratic formula by completing the square</td>
<td>Students can complete this on a white board: Have the students write out a quadratic equation in standard form (with values for a, b, and c where a does not equal 1). Have them solve this equation by completing the square. Now have them write out $ax^2 + bx + c = 0$ and solve this by completing the square. If they do it correctly, they should generate the quadratic formula.</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Solving and Applying</td>
<td>Making a connection</td>
<td>Give the students a quadratic inequality and have them graph it on their graphing calculator (or use Desmos), demonstrate the solution using interval notation. Give them a few more examples with a variety of solution types and a variety of types of quadratic functions (some in factored form). Discuss what conclusions can be made about the solutions (they should notice that the critical points come from the roots of the quadratic equations). Now demonstrate the test-point method as another way of solving a quadratic inequality without graphing on a coordinate plane.</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>
Unit 8: Functions

**Subject:** College Algebra A  
**Grade:** 10, 11, 12  
**Name of Unit:** Functions  
**Length of Unit:** 11 class periods  
**Overview of Unit:** Students will graph a variety of functions using domain, range, tables, and transformations. Students will use function notation to combine functions, find the 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 - KNOWLEDGE COLLECTOR.3.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
- 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.
<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>
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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>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>
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<tr>
<td>new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).</td>
<td>Create</td>
<td>Apply</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>Derive</td>
<td>Apply</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>Compose</td>
<td>Apply</td>
<td>3</td>
</tr>
</tbody>
</table>

**Essential Questions:**
1. How do you graph a function by making a table of values?
2. How do you transform a graph?
3. How do you combine functions?
4. How do you find the inverse of a function?
5. How are different forms of variation modeled?

**Enduring Understanding/Big Ideas:**
1. Graph a variety of functions by plotting points.
2. Transform a graph or describe transformations to a graph that is linear, quadratic, absolute-value or square-root.
3. Use the basic operations to combine functions to obtain new functions and finding the composition of functions.
4. Finding the inverse of 1-1 functions and using the composition to show that functions are inverses.
5. Variation models include direct, inverse and joint.
### Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformations</td>
<td>Composition</td>
</tr>
<tr>
<td>Inverse</td>
<td>Absolute Value</td>
</tr>
<tr>
<td>Variation (Direct, Inverse, Joint)</td>
<td>Quadratic</td>
</tr>
<tr>
<td>Translate</td>
<td>One to One</td>
</tr>
<tr>
<td>Reflection</td>
<td></td>
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<tr>
<td>Stretching/Shrinking</td>
<td></td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
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.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.

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: Transformations exploration
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:
- 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-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: Review the basic families of functions and their associated graphs (linear, quadratic, square root, absolute value). Then students will graph several with vertical shifting, drawing their own conclusions about what causes the graph to shift and by how much. Same scenario with horizontal shifting, reflections about the x-axis, and reflections about the y-axis. To tie everything together students will be given a graph with multiple transformations. Without graphing, using their previous findings, they will determine what kind of transformation has occurred. They can check their findings by graphing on their calculator (or in Desmos).

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
Topic 4: Inverse Functions

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/Instructions: 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.) Students will complete the “LEGO Prices” activity in Desmos. In this activity, students use sliders to explore the relationship between price and number of pieces for various Star Wars LEGO sets and to make several predictions based on that model. Students will also interpret the parameters of their equation in context.
### 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>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, $0.45 for each additional minute, plan B: $45 monthly fee, 900 anytime minutes, $0.30 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>Analyzing Graphs</td>
<td>Transformations exploration</td>
<td>Review the basic families of functions and their associated graphs (linear, quadratic, square root, absolute value). Then students will graph several with vertical shifting, drawing their own conclusions about what causes the graph to shift and by how much. Same scenario with horizontal shifting, reflections about the x-axis, and reflections about the y-axis. To tie everything together students will be given a graph with multiple transformations. Without graphing, using their previous findings, they will determine what kind of transformation has occurred. They can check their findings by graphing on their calculator (or in Desmos).</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.)</td>
<td>15 minutes</td>
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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.

| Inverse Functions | 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. | 30 minutes |
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.