High School Algebra IIB Curriculum

**Course Description:** The course is designed to cover the second half of the Algebra II curriculum. This course includes the study of a variety of functions (linear, quadratic, higher order polynomials, exponential, absolute value, logarithmic and rational) learning to graph, compare, perform operations and manipulate them in order to solve, analyze and apply to problems. Students will use probability and statistics to evaluate outcomes of decisions. Students develop rigorous problem solving skills, logical reasoning and mathematical communication skills required for success in higher math courses and real life experiences. *Graphing calculators are required.

**Scope and Sequence:**

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Unit</th>
<th>Instructional Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 weeks</td>
<td>Rationals</td>
<td>Topic 1: Simplify and Solve Rational Expressions/ Equations</td>
</tr>
</tbody>
</table>
| 4 weeks   | Rational Exponents and Radicals | Topic 1: Use Properties of Exponents  
Topic 2: Relationship Between Rational Exponents and Radicals  
Topic 3: Operations of Radical Expressions  
Topic 4: Solve Radical/ Rational Equations  
Topic 5: Graph Radical/ Rational Exponent Functions |
| 3 weeks   | Functions                     | Topic 1: Parent Functions and Transformations  
Topic 2: Operations, Composition, and Inverse of Functions |
| 4 weeks | Logs          | Topic 1: Definitions of Logs  
|         |              | Topic 2: Evaluate and Simplify Logs  
|         |              | Topic 3: Solve Exponential and Log Equations  
|         |              | Topic 4: Graph Exponential and Log Functions  
|         |              | Topic 5: Apps Exponential and Log Functions  
| 3 weeks | Statistics and Probability | Topic 1: Probability  
|         |              | Topic 2: Data Analysis  

Unit 1: Rationals

Subject: Algebra IIB
Grade: 9, 10, 11, 12
Name of Unit: Rationals
Length of Unit: 3 weeks
Overview of Unit: Students will simplify rational expressions and solve rational equations.

Priority Standards for unit:
- 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 Standards for unit:
- Alg2.APR.A.1: Extend the knowledge of factoring to include factors with complex coefficients.
- Alg2.APR.A.3: Find the least common multiple of two or more polynomials.
- Alg2.APR.A.4: Add, subtract, multiply and divide rational expressions.
- Alg2.REI.A.2: Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.
- 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-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.B - use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
- ISTE-CREATIVE COMMUNICATOR.6.A - choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
- ISTE-CREATIVE COMMUNICATOR.6.B - create original works or responsibly repurpose or remix digital resources into new creations.
- ISTE-CREATIVE COMMUNICATOR.6.C - communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
- ISTE-CREATIVE COMMUNICATOR.6.D - publish or present content that customizes the message and medium for their intended audiences.
Unwrapped Concepts (Students need to know)

<table>
<thead>
<tr>
<th>Zeros of polynomials when suitable factorizations are available</th>
</tr>
</thead>
</table>

Unwrapped Skills (Students need to be able to do)

<table>
<thead>
<tr>
<th>Identify</th>
<th>Apply</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>Apply</td>
<td>3</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How do you simplify and solve rational expressions?
2. Why do you have to check for extraneous solutions?

Enduring Understanding/Big Ideas:
1. To simplify or solve rational expressions you must first look for any numbers that would not be in the domain of the expression or equation. To fully simplify or solve, you must use previous knowledge of algebraic methods to find the desired outcome.
2. The reason to check for extraneous solutions is because you may have a solution after solving that does not satisfy the original equation.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zeros</td>
<td>Polynomial</td>
</tr>
<tr>
<td>Roots</td>
<td>Greatest Common Factor</td>
</tr>
<tr>
<td>X-Intercept(s)</td>
<td>Factor by Grouping</td>
</tr>
<tr>
<td>Relative (Local) Extrema</td>
<td>Zeros</td>
</tr>
<tr>
<td></td>
<td>Roots</td>
</tr>
<tr>
<td></td>
<td>X-Intercept(s)</td>
</tr>
<tr>
<td></td>
<td>Remainder Theorem</td>
</tr>
<tr>
<td></td>
<td>Fundamental Theorem of Algebra</td>
</tr>
<tr>
<td></td>
<td>Synthetic Division</td>
</tr>
<tr>
<td></td>
<td>End-Behavior</td>
</tr>
<tr>
<td></td>
<td>Relative (Local) Extrema</td>
</tr>
<tr>
<td></td>
<td>Rational</td>
</tr>
<tr>
<td></td>
<td>Extraneous</td>
</tr>
<tr>
<td></td>
<td>Asymptote</td>
</tr>
<tr>
<td></td>
<td>Degree of a Polynomial</td>
</tr>
<tr>
<td></td>
<td>Leading Coefficient</td>
</tr>
<tr>
<td></td>
<td>Conjugate</td>
</tr>
<tr>
<td></td>
<td>Rationalize</td>
</tr>
</tbody>
</table>

Resources for Vocabulary Development: Textbook
Engaging Experience 1
Title: Kepler’s Third Law of Planetary Motion
Suggested Length of Time: ½ of a 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.

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 complete the activity “Kepler’s Third Law of Planetary Motion.” This is an applied activity for simplifying rational expressions. This should be done after the lesson for simplifying rational expressions is completed. Kepler's Third Law

Bloom’s Levels: Apply

Webb’s DOK: 2
**Engaging Scenario:** Rational Equations Project
Students will create a digital presentation using Prezi, Google slides, Power Point, a video, etc., that recaps how to simplify, multiply, divide, add, and subtract rational expressions and solve rational equations.
Examples:
- Rational Expressions Project
- Rational Expressions Project #2

**Rubric for Engaging Scenario:** to be created
## 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 and Solve Rational Expressions/Equations</td>
<td>Kepler’s Third Law of Planetary Motion</td>
<td>Students will complete the activity “Kepler’s Third Law of Planetary Motion.” This is an applied activity for simplifying rational expressions. This should be done after the lesson for simplifying rational expressions is completed. <a href="https://example.com">Kepler's Third Law</a>.</td>
<td>½ of a class period</td>
</tr>
</tbody>
</table>
Unit 2: Rational Exponents and Radicals

Subject: Algebra IIB
Grade: 9, 10, 11, 12
Name of Unit: Rational Exponents and Radicals
Length of Unit: 4 weeks
Overview of Unit: Using properties of exponents students will discover the relationship between rational exponents and radical functions. This will transition into simplifying, solving, and graphing rational exponent and radical equations.

Priority 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.
- Alg2.NQ.A.1: Extend the system of powers and roots to include rational exponents.

Supporting Standards for unit:
- 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.
- 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.B - use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

<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 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.</td>
<td>Describe</td>
<td>Understand</td>
<td>2</td>
</tr>
</tbody>
</table>
the system of powers and roots to include rational exponents.

<table>
<thead>
<tr>
<th>Extend</th>
<th>Apply</th>
<th>3</th>
</tr>
</thead>
</table>

**Essential Questions:**
1. Why are properties of exponents important in relation to understanding rational exponent and radicals?
2. How do you simplify or solve rational exponent or radical expressions or equations?
3. How do you graph square root, cubic and cube root functions?

**Enduring Understanding/Big Ideas:**
1. Understanding the properties of exponents allows you to simplify expressions.
2. You need to isolate the rational exponent term or radical term and then “undo” the exponent or radical by using the inverse operation. You must check your answer(s) for extraneous solutions.
3. You need to identify the “locator point”, starting point of a square root, point of inflection for a cube or cubic root function. You can then either use transformations from the parent graph or a table to find additional points to create the rest of the graph.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse</td>
<td>Index of a radical</td>
</tr>
<tr>
<td></td>
<td>Radical</td>
</tr>
<tr>
<td></td>
<td>Radicand</td>
</tr>
<tr>
<td></td>
<td>Rational Exponent</td>
</tr>
<tr>
<td></td>
<td>Point of Inflection</td>
</tr>
<tr>
<td></td>
<td>Extraneous</td>
</tr>
<tr>
<td></td>
<td>Transformations</td>
</tr>
<tr>
<td></td>
<td>Parent graph</td>
</tr>
<tr>
<td></td>
<td>Principal root</td>
</tr>
</tbody>
</table>

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

Title: Quizzizz Exponent Properties

Suggested Length of Time: ¼ of a class period

Standards Addressed

Priority:

- Alg2.NQ.A.1: Extend the system of powers and roots to include rational exponents

Supporting:

- Alg2.NQ.A.2: Create and recognize equivalent expressions involving radical and exponential forms of expressions.
- 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 complete a quizzizz activity on their computer. Ex. Exponent Properties

Bloom’s Levels: Apply

Webb’s DOK: 3
Topic 2: Relationship Between Rational Exponents and Radicals

Engaging Experience 1
Title: White Board Activity
Suggested Length of Time: ¼ of a class period
Standards Addressed

Priority:
- Alg2.NQ.A.1: Extend the system of powers and roots to include rational exponents

Supporting:
- Alg2.NQ.A.2: Create and recognize equivalent expressions involving radical and exponential forms of expressions.

Detailed Description/Instructions: Teacher gives either a rational exponent expression and students rewrite as a radical expression, or they give a radical expression and students rewrite as a rational exponent expression. Can be turned into a game to engage students more.

Bloom’s Levels: Apply
Webb’s DOK: 3
Engaging Experience 1
Title: Quia Quiz
Suggested Length of Time: ¼ of a class period
Standards Addressed

Priority:

• Alg2.NQ.A.1: Extend the system of powers and roots to include rational exponents.

Supporting:

• Alg2.NQ.A.3: Add, subtract, multiply and divide radical expressions.
• 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 take the Quia quiz Multiplying, Dividing, and Simplifying Radicals

Bloom’s Levels: Apply
Webb’s DOK: 3
Engaging Experience 1
Title: Quia Activity
Suggested Length of Time: ½ of a class period
Standards Addressed

Priority:
- Alg2.NQ.A.1: Extend the system of powers and roots to include rational exponents.

Supporting:
- Alg2.NQ.A.4: Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.
- 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 complete the Quia game Solving Radical Equations on their laptop.

Bloom’s Levels: Apply

Webb’s DOK: 3
Engaging Experience 1

Title: Polygraph: Square Root Functions

Suggested Length of Time: ⅓ of a class period

Standards Addressed

Priority:

- 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.

Supporting:

- 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.B - use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

Detailed Description/Instructions: Students play the desmos game Polygraph: Square Root Functions.

Bloom’s Levels: Understand

Webb’s DOK: 2
Engaging Scenario: Ghosts in the Graveyard
This is a game that reviews simplifying exponents and radicals. Students are placed in teams of 3 or 4 students. Each team is given a question card where all members of the team must complete all parts. One student then brings all their answer sheets up to the teacher who randomly picks a sheet. If all the parts are correct they exchange their question card for a new card and then place one of their ghosts on a tombstone. If they are incorrect they are sent back to correct their errors. They continue this process until the time given for the game has expired (typically played for about 45 minutes). Each tombstone has a different point value assigned (0, 25, 50, 75, or 100). You designate this before the game has started but don’t reveal it to the students until the game has ended. Once the point values have been revealed the points are added up to see which team wins.

Ghosts in the Graveyard

Rubric for Engaging 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>Use Properties of Exponents</td>
<td>Quizzizz Exponent Properties</td>
<td>Students complete a quizzizz activity on their computer. Ex. <a href="#">Exponent Properties</a></td>
<td>¼ of a class period</td>
</tr>
<tr>
<td>Relationship Between Rational Exponents and Radicals</td>
<td>White Board Activity</td>
<td>Teacher gives either a rational exponent expression and students rewrite as a radical expression, or they give a radical expression and students rewrite as a rational exponent expression. Can be turned into a game to engage students more.</td>
<td>¼ of a class period</td>
</tr>
<tr>
<td>Operations of Radical Expressions</td>
<td>Quia Quiz</td>
<td>Students take the Quia quiz <a href="#">Multiplying, Dividing, and Simplifying Radicals</a></td>
<td>¼ of a class period</td>
</tr>
<tr>
<td>Solve Radical/Rational Equations</td>
<td>Quia Activity</td>
<td>Students complete the quia game <a href="#">Solving Radical Equations</a> on their laptop.</td>
<td>½ of a class period</td>
</tr>
<tr>
<td>Graph Radical/Rational Exponent Functions</td>
<td>Polygraph: Square Root Functions</td>
<td>Students play the desmos game <a href="#">Polygraph: Square Root Functions</a>.</td>
<td>¼ of a class period</td>
</tr>
</tbody>
</table>
Unit 3: Functions

Subject: Algebra IIB
Grade: 9, 10, 11, 12
Name of Unit: Functions
Length of Unit: 3 weeks
Overview of Unit: Students will perform function composition and find the inverse of a function. They will also identify parent functions and describe and graph transformations.

Priority 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.

Supporting Standards for unit:
• 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.
• Alg2.IF.A.2: Translate between equivalent forms of functions.
• 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-KNOWLEDGE COLLECTOR.3.D - build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
• ISTE-INNOVATIVE DESIGNER.4.A - know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
• ISTE-INNOVATIVE DESIGNER.4.C - develop, test and refine prototypes as part of a cyclical design process.
• ISTE-INNOVATIVE DESIGNER.4.D - exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
• ISTE-GLOBAL COLLABORATOR.7.B - use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
Unwrapped Concepts
(Students need to know)

<table>
<thead>
<tr>
<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 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.</td>
<td>Describe</td>
<td>Understand 2</td>
</tr>
</tbody>
</table>

**Essential Questions:**

1. How do you find the inverse of a function?
2. How do you perform the composition of functions?
3. Why is it important to know parent functions?
4. How do you transform the parent functions?

**Enduring Understanding/Big Ideas:**

1. To find the inverse of a function you need to switch the inputs and the outputs, keeping in mind the restrictions on the domain of the function.
2. You substitute the inside function into the outside function, or the results of the inside function into the outside function.
3. The parent function is the simplest form of each function and all transformations are based off of the parent graph.
4. You use the a, b, h, and k values of af(bx-h)+k to translate, reflect, stretch and/or compress each point.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse</td>
<td>Relation</td>
</tr>
<tr>
<td>Domain</td>
<td>Function</td>
</tr>
<tr>
<td>Range</td>
<td>Composition</td>
</tr>
<tr>
<td></td>
<td>Parent function</td>
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<tr>
<td></td>
<td>Transformation</td>
</tr>
<tr>
<td></td>
<td>Reflection</td>
</tr>
<tr>
<td></td>
<td>Vertical stretch</td>
</tr>
<tr>
<td></td>
<td>Vertical compression</td>
</tr>
<tr>
<td></td>
<td>Translation</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** textbook
Topic 1: Parent Functions and Transformations

Engaging Experience 1
Title: Card Match
Suggested Length of Time: ⅓ of a class period
Standards Addressed
  
  
  Priority:
  
  • 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 match and sort equations, graphs, and transformations on desmos or with the cards in the worksheet (found in the google drive Algebra II Resources).

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

Engaging Experience 2
Title: Desmos Transformation Activities
Suggested Length of Time: ½ of a class period for each
Standards Addressed
  
  Priority:
  
  • 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.

Supporting:
  
  • 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.B - use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

Detailed Description/Instructions: Students complete desmos activities located at Desmos Transformation Activities.

Bloom’s Levels: Understand
We
Engaging Experience 1
Title: Composing Functions Exploration/Practice with Inverses
Suggested Length of Time: ½ of a class period for each
Standards Addressed

*Priority:*
- 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.

*Supporting:*
- 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.B - use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

**Detailed Description/Instructions:** Students complete the desmos activity Composing Functions Explorations and/or Practice with Inverses.

**Bloom’s Levels:** Understand

**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.)

Desmos Art Project

Using their knowledge of parent functions, transformations, domain and range student will design an art project of their choice. This project is to be done using desmos.com. Students will need one day in class to be introduced to the project and practice. The project will be completed outside of class on a day designated by the teacher.

[Desmos Art Project Tutorial](#)

[Art Project Examples](#)

**Rubric for Engaging Scenario:** to be created
<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>Parent Functions and Transformations</td>
<td>Card Match</td>
<td>Students match and sort equations, graphs, and transformations on desmos or with the cards in the worksheet (found in the google drive <a href="#">Algebra II Resources</a>).</td>
<td>⅓ of a class period</td>
</tr>
<tr>
<td>Parent Functions and Transformations</td>
<td>Desmos Transformation Activities</td>
<td>Students complete desmos activities located at <a href="#">Desmos Transformation Activities</a>.</td>
<td>⅓ of a class period for each</td>
</tr>
<tr>
<td>Operations, Composition, and Inverse of Functions</td>
<td>Composing Functions Exploration/ Practice with Inverses</td>
<td>Students complete the desmos activity <a href="#">Composing Functions Explorations</a> and/or <a href="#">Practice with Inverses</a>.</td>
<td>⅓ of a class period for each</td>
</tr>
</tbody>
</table>
Unit 4: Logs

Subject: Algebra IIB
Grade: 9, 10, 11, 12
Name of Unit: Logs
Length of Unit: 4 weeks
Overview of Unit: Students will understand the relationship between exponential and logarithmic equations. Understanding these concepts students will be able to simplify, solve, and graph exponentials and logarithms.

Priority Standards for unit:
- Alg2.FM.A.1: Create functions and use them to solve applications of quadratic and exponential function model problems.
- 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.SSE.A.1: Develop the definition of logarithms based on properties of exponents.

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.
- 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.C - break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- 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-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-CREATIVE COMMUNICATOR.6.C - communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.

<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>Create functions (logarithms)</td>
<td>Create</td>
<td>Create</td>
<td>3</td>
</tr>
<tr>
<td>solve applications of quadratic and exponential function model problems.</td>
<td>Solve</td>
<td>Apply</td>
<td>3</td>
</tr>
<tr>
<td>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.</td>
<td>Describe</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>The definition of logarithms based on properties of exponents.</td>
<td>Develop</td>
<td>Analyze</td>
<td>3</td>
</tr>
</tbody>
</table>

Essential Questions:
1. How do you model exponential and logarithmic functions graphically and algebraically?
2. How do you simplify and evaluate exponential and logarithmic expressions?
3. How do you solve exponential and logarithmic equations?

Enduring Understanding/Big Ideas:
1. Modeling exponential functions requires you to identify whether the function involves growth or decay. To graph a logarithmic function, you must be able to find the inverse of an exponential function and graph the new points. To accurately graph exponential and logarithmic functions you must identify vertical and horizontal asymptotes.
2. To simplify or evaluate exponential and logarithmic expression you must be able manipulate one form to the other and use exponent and logarithm rules.
3. To solve exponential and logarithmic equations you must use mathematical rules to isolate the desired variable.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponential Function</td>
<td>Exponential Function</td>
</tr>
<tr>
<td>Exponential Growth</td>
<td>Exponential Growth</td>
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<tr>
<td>--------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Exponential Decay</td>
<td>Exponential Decay</td>
</tr>
<tr>
<td>Logarithm</td>
<td>Asymptote</td>
</tr>
<tr>
<td>Natural Logarithm</td>
<td>Natural Base $e$</td>
</tr>
<tr>
<td></td>
<td>Logarithm</td>
</tr>
<tr>
<td></td>
<td>Natural Logarithm</td>
</tr>
<tr>
<td></td>
<td>Compound Interest</td>
</tr>
<tr>
<td></td>
<td>Growth Factor</td>
</tr>
<tr>
<td></td>
<td>Decay Factor</td>
</tr>
<tr>
<td></td>
<td>Base</td>
</tr>
<tr>
<td></td>
<td>Change of Base</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
# Topic 1: Definitions of Logs

## Engaging Experience 1

**Title:** Exponential, Inverses and Logs  
**Suggested Length of Time:** ½-¾ 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.
- 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-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-INNOVATIVE DESIGNER.4.A - know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

### Detailed Description/Instructions:

Students will use their knowledge of the graphs of exponential functions and their knowledge of inverses to discover the definition of logarithms. 

**Discovering Logarithms** Students will use their computers and along with either white boards or paper to complete each step of the activity culminating with the discovery of the relationship between exponential and logarithmic functions.

**Bloom’s Levels:** Create

**Webb’s DOK:** 3
Engaging Experience 1

Title: Logarithm War

Suggested Length of Time: ½ of a class period

Standards Addressed

Priority:

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

Supporting:

- Alg2.SSE.A.3: Use properties of logarithms to solve equations or find equivalent expressions.

Detailed Description/Instructions: Students will be in groups of two. This activity is based on the common card game of “war.” The highest card placed on the table wins. The player who ends up with all of the cards wins the game. Students will place a card on the table then evaluate or simplify the expression to find which card is higher. Logarithm War

Bloom’s Levels: Apply
Webb’s DOK: 3
**Engaging Experience 1**

**Title:** Exponential and Log Jeopardy

**Suggested Length of Time:** ¾ of a class period

**Standards Addressed**

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

*Supporting:*
- Alg2.SSE.A.3: Use properties of logarithms to solve equations or find equivalent expressions.

**Detailed Description/Instructions:** As a class you will complete the Exponential and Log Jeopardy activity. The class may be split into teams and the teacher may decide how each team participates. This allows for students to complete the Jeopardy activity with a small group and as a class. [Exponential and Log Jeopardy](#)

**Bloom’s Levels:** Apply

**Webb’s DOK:** 3
Engaging Experience 1

Title: Starbucks Growth

Suggested Length of Time: ¾ of a class period

Standards Addressed

Priority:

- 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.

Supporting:

- ISTE-KNOWLEDGE COLLECTOR.3.C - curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
- 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-INNOVATIVE DESIGNER.4.A - know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 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-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-CREATIVE COMMUNICATOR.6.C - communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.

Detailed Description/Instructions: Students will use the “Starbucks Growth” information on the link below to create a chart of their choice. This chart may be designed in any program that they would like. Have them attempt to graph this data either by hand or by the program that they made the table on. This will allow them to see some sort of growth. Help them come up with the exponential function that could fit the data. Finally talk about the relationship between exponentials and logarithms and have them derive and graph the logarithmic function that is the inverse of the discovered exponential function. Starbucks Growth

Bloom’s Levels: Understand

Webb’s DOK: 2
Engaging Experience 1
Title: What is real life?
Suggested Length of Time: 1 class period

Standards Addressed

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

Supporting:
- Alg2.SSE.A.4: Understand why logarithmic scales are used, and use them to solve problems.

Detailed Description/Instructions: This activity is very open to the teacher interpretation. Take a class period and work with the students to understand how interest works when buying a car or home. This can carry over into school loans as well. Treat this almost as a personal finance day and talk to the students about how this understanding these concepts can really play a large role into their everyday life.

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

**Engaging Scenario:** Murder in the First Degree - Death of Mr. Spud

Students will explore how the internal temperature of a potato decreases over time after being boiled. They will use this information and relate it to exponential growth and decay along with logarithms. This activity has students boil a potato and collect data regarding the internal temperature which may be related to how forensic scientists use the same process and data to determine the time of death with investigating a homicide. Students will be in groups and each group will share the outcome of their experiment with the class. Upon finishing the presentation of each group's “time of death” discuss why each group may have been different. This activity may require assistance from the science and/or FACS department in your building.

[Murder in the First Degree - Death of Mr. Spud](#)

**Rubric for Engaging Scenario:** to be created
### 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>Definitions of Logs</td>
<td>Exponential, Inverses and Logs</td>
<td>Students will use their knowledge of the graphs of exponential functions and their knowledge of inverses to discover the definition of logarithms. <strong>Discovering Logarithms</strong> Students will use their computers and along with either white boards or paper to complete each step of the activity culminating with the discovery of the relationship between exponential and logarithmic functions.</td>
<td>½-¾ of a class period</td>
</tr>
<tr>
<td>Evaluate and Simplify Logs</td>
<td>Logarithm War</td>
<td>Students will be in groups of two. This activity is based on the common card game of “war.” The highest card placed on the table wins. The player who ends up with all of the cards wins the game. Students will place a card on the table then evaluate or simplify the expression to find which card is higher. <strong>Logarithm War</strong></td>
<td>½ of a class period</td>
</tr>
<tr>
<td>Solve Exponential and Log Equations</td>
<td>Exponential and Log Jeopardy</td>
<td>As a class you will complete the Exponential and Log Jeopardy activity. The class may be split into teams and the teacher may decide how each team participates. This allows for students to complete the Jeopardy activity with a small group and as a class. <strong>Exponential and Log Jeopardy</strong></td>
<td>¾ of a class period</td>
</tr>
<tr>
<td>Graph Exponential and Log Functions</td>
<td>Starbucks Growth</td>
<td>Students will use the “Starbucks Growth” information on the link below to create a chart of their choice. This chart may be designed in any program that they would like. Have them attempt to graph this data either by hand or by the program that they use.</td>
<td>¾ of a class period</td>
</tr>
</tbody>
</table>
made the table on. This will allow them to see some sort of growth. Help them come up with the exponential function that could fit the data. Finally talk about the relationship between exponentials and logarithms and have them derive and graph the logarithmic function that is the inverse of the discovered exponential function. Starbucks Growth

| Apps Exponential and Log Functions | What is real life? | This activity is very open to the teacher interpretation. Take a class period and work with the students to understand how interest works when buying a car or home. This can carry over into school loans as well. Treat this almost as a personal finance day and talk to the students about how this understanding these concepts can really play a large role into their everyday life. | 1 class period |
Unit 5: Statistics and Probability

Subject: Algebra IIB
Grade: 9, 10, 11, 12
Name of Unit: Statistics and Probability
Length of Unit: 3 weeks
Overview of Unit: Students will study and understand the different types of probability to understand outside applications. Using their understanding of statistics students will be able to analyze data and distribution to find relationships and make conclusions from the experiments or studies.

Priority Standards for unit:
- Alg2.DS.A.7: Evaluate reports based on data.

Supporting Standards for unit:
- Alg2.DS.A.1: Analyze how random sampling could be used to make inferences about population parameters.
- Alg2.DS.A.2: Determine whether a specified model is consistent with a given data set.
- Alg2.DS.A.3: Describe and explain the purposes, relationship to randomization and differences among sample surveys, experiments and observational studies.
- Alg2.DS.A.4: Use data from a sample to estimate characteristics of the population and recognize the meaning of the margin of error in these estimates.
- Alg2.DS.A.5: Describe and explain how the relative sizes of a sample and the population affect the margin of error in predictions.
- Alg2.DS.A.6: Analyze decisions and strategies using probability concepts.
- Alg2.DS.B.1: Know and use the characteristics of normally distributed data sets; predict what percentage of the data will be above or below a given value that is a multiple of standard deviations above or below the mean.
- Alg2.DS.B.2: Fit a data set to a distribution using its mean and standard deviation to determine whether the data is approximately normally distributed.
- ISTE-KNOWLEDGE COLLECTOR.3.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
- 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-CREATIVE COMMUNICATOR.6.A - choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
- ISTE-CREATIVE COMMUNICATOR.6.B - create original works or responsibly repurpose or remix digital resources into new creations.
• ISTE-CREATIVE COMMUNICATOR.6.C - communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
• ISTE-CREATIVE COMMUNICATOR.6.D - publish or present content that customizes the message and medium for their intended audiences.

<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>Reports based on data</td>
<td>Evaluate</td>
<td>Evaluate</td>
<td>4</td>
</tr>
</tbody>
</table>

**Essential Questions:**
1. How do you calculate the measures of central tendencies?
2. Why does the sample size, population, and margin of error help in statistical analysis?
3. How does distribution of data play a part in statistical analysis?
4. How do you find the probability of an event?

**Enduring Understanding/Big Ideas:**
1. Measures of Central Tendency include, but are not limited to mean, median and mode and may be calculated by formulas or a specific process.
2. Sample size, population, and margin of error are important in statistical analysis to determine the validity of a study.
3. Correctly analyzing the distribution of data will allow for more valid conclusions and decision making from the given situation.
4. To correctly identify the probability of an event you must compare the desired outcomes to the total number of outcomes. Must identify whether the event is disjoint, dependent, independent, etc.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
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</thead>
<tbody>
<tr>
<td>Skewed</td>
<td>Permutation</td>
</tr>
<tr>
<td>Statistics</td>
<td>Combination</td>
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<tr>
<td>Mean</td>
<td>Binomial Theorem</td>
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<tr>
<td>Median</td>
<td>Probability</td>
</tr>
<tr>
<td>Mode</td>
<td>Compound Event</td>
</tr>
<tr>
<td>Range</td>
<td>Overlapping Events</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>Disjoint Events</td>
</tr>
<tr>
<td>Normal Distribution</td>
<td>Independent Events</td>
</tr>
<tr>
<td>Normal Curve</td>
<td>Dependent Events</td>
</tr>
<tr>
<td>Permutation</td>
<td>Conditional Probability</td>
</tr>
<tr>
<td>Combination</td>
<td>Random Variable</td>
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<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>Theoretical Probability</td>
<td>Binomial Distribution</td>
</tr>
<tr>
<td>Experimental Probability</td>
<td>Theoretical Probability</td>
</tr>
<tr>
<td>Geometric Probability</td>
<td>Experimental Probability</td>
</tr>
<tr>
<td></td>
<td>Geometric Probability</td>
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<tr>
<td></td>
<td>Symmetric</td>
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<tr>
<td></td>
<td>Skewed</td>
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<td>Normal Distribution</td>
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<td></td>
<td>Normal Curve</td>
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<td></td>
<td>Standard Normal Distribution</td>
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<td></td>
<td>Z-score</td>
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<tr>
<td></td>
<td>Sample</td>
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<td></td>
<td>Unbiased Sample</td>
</tr>
<tr>
<td></td>
<td>Biased Sample</td>
</tr>
<tr>
<td></td>
<td>Margin of Error</td>
</tr>
<tr>
<td></td>
<td>Measures of Central Tendency</td>
</tr>
</tbody>
</table>

**Resources for Vocabulary Development:** Textbook
**Engaging Experience 1**
**Title:** Casino Day
**Suggested Length of Time:** at least 1 class period

**Standards Addressed**

*Priority:*
- Alg2.DS.A.7: Evaluate reports based on data.

*Supporting:*
- Alg2.DS.A.6: Analyze decisions and strategies using probability concepts.

**Detailed Description/Instructions:** After completion of the sections on probability, set up a day where the students are playing casino style games. This includes but is not limited to card games and roulette. Stations could be set up to play a game of poker, blackjack, war and many other card games. At each station, students would need to complete the information regarding probability involved in each game. This must also happen with roulette.
- Poker
- Blackjack
- Roulette

**Bloom’s Levels:** Evaluate

**Webb’s DOK:** 4
Topic 2: Data Analysis

Engaging Experience 1
Title: Measures of Spread
Suggested Length of Time: 1 class period

Standards Addressed

Priority:
- Alg2.DS.A.7: Evaluate reports based on data.

Supporting:
- ISTE-KNOWLEDGE COLLECTOR.3.B - evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
- 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: This activity will have students use standard deviation to distinguish between two different methods. Students must determine whether one method is better than the other. Statistical analysis of mean and median along with interquartile range and standard deviation are assessed in this activity.
- Measures of Central Tendency
- Standard Deviation

Bloom’s Levels: Evaluate

Webb’s DOK: 4
Engaging Scenario

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

Statistics Project

Students will work in groups of 2 or 3 for this project. Each group will create a survey question (to be verified by your teacher). They will make conjectures about their survey topic/activity before surveying (what they think they will find . . .). Each group will survey 40 students and analyze the data. They will then present their findings to the class. The project is designed for an Accelerated Algebra 2 class but can be modified for an Algebra 2 class.

Statistics Project

Rubric for Engaging Scenario: to be created
# 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>
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</thead>
<tbody>
<tr>
<td>Probability</td>
<td>Casino Day</td>
<td>After completion of the sections on probability, set up a day where the students are playing casino style games. This includes but is not limited to card games and roulette. Stations could be set up to play a game of poker, blackjack, war and many other card games. At each station, students would need to complete the information regarding probability involved in each game. This must also happen with roulette.</td>
<td>at least 1 class period</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Measures of Spread</td>
<td>This activity will have students use standard deviation to distinguish between two different methods. Students must determine whether one method is better than the other. Statistical analysis of mean and median along with interquartile range and standard deviation are assessed in this activity.</td>
<td>1 class period</td>
</tr>
</tbody>
</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.

**Symbols:**

- This symbol depicts an experience that can be used to assess a student’s 21st Century Skills using the rubric provided by the district.

- This symbol depicts an experience that integrates professional skills, the development of professional communication, and/or the use of professional mentorships in authentic classroom learning activities.