Waterford Public Schools

Grades 9-12

Mathematics Curriculum Revision

2022

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Curriculum Revision Committee

Grades 9-12 Mathematics Curriculum

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COURSE NAME: Prealgebra First Unit - Prealgebra IM Unit 1: Scale Copies Est. Time: 8 Weeks (10 Lessons, class meets every other day)	
OVERVIEW *In this unit, student will take existing diagrams and drawings and make bigger and smaller copies of them by using a scale. Students will learn that multiplication and division are the operations used to find measurements on the scaled copy.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **7.G.A**: Draw, construct, and describe geometrical figures and describe the relationships between them. **7.RP.A**: Analyze proportional relationships and use them to solve real-world and mathematical problems.	• CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #3: Construct viable arguments. • SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise. MP #1 Make sense of problems.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Scaled drawings have specific properties and characteristics. • Scaled figures have corresponding parts that are used to set up ratios and proportional relationships. • Scaled figures are constructed through multiplication or division not addition and subtraction.	• How do we use a scale to find actual measurements? • How can we use ratios to reproduce a drawing at a different scale?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can use the correct operations on the side lengths of a figure to produce a scaled copy.

How to compute lengths of polygons based on scaled drawings. How to reproduce geometric figures from similar scaled drawings.	2. I can describe the change on a drawing or diagram when I use a scale factor greater than 1, less than 1, or equal to 1. 3. I can identify if a figure is a scaled copy of another figure. 4. I can identify corresponding parts in a pair of similar figures.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: Scaled Drawings Prealgebra Unit 1 End of Unit Assessment 1. I can use the correct operations on the side lengths of a figure to produce a4. scaled copy. TEST Question: #1, #2 2. I can describe the change on a drawing or diagram when I use a scale factor greater than 1, less than 1, or equal to 1. TEST Question: #6, #3 3. I can identify if a figure is a scaled copy of another figure. TEST Question: #4, #5 4. I can identify corresponding parts, In a pair of figures. Test Question: #6, #5	Unit 1 Cool Downs DESMOS Interactive lessons Skill based white board activities
Performance Task: Students will work collaboratively to create a scaled copy of the classroom. using the Essential Question: How can I use ratios to reproduce a drawing at a different scale? ● Transfer Skills: Critical Thinking, Self-Direction ● Understandings: #1, 2 ● Learning Targets: #3, 4	

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Characteristics of scaled drawings</td><td>Estimated # of Lessons: 4</td></tr>
<tr><td>Learning Target(s):

1. I can identify if a figure is a scaled copy of another figure.

2. I can identify corresponding parts in a pair of figures.</td><td>Essential Questions:

• How do we use a scale to find actual measurements?
• How can we use ratios to reproduce a drawing at a different scale?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Students work independently to explore scaled drawings and their characteristics.
2. Students create a scaled monster to identify what makes scaled copies similar.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

<table>
<tr><td>Second Unit Topic: Creating scaled drawings of figures.</td><td>Estimated # of Lessons: 6</td></tr>
<tr><td>Learning Target(s):

3. I can use the correct operations on the side lengths of a figure to produce a scaled copy.

4. I can describe the change on a drawing or diagram when I use a scale factor greater than 1, less than 1, or equal to 1.</td><td>Essential Questions:

• How do I use a scale to find actual measurements?
• How can I use ratios to reproduce a drawing at a different scale?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Students explore the operations involved in creating scaled copies of figures.
2. Students create scaled drawings of figures.
3. Students explore the effect of different scale factors on figures.</td></tr>
</table>

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<table>
<tr><td colspan="2">COURSE NAME: Prealgebra Second Unit - Prealgebra IM Unit 2: Proportional Relationships
Est. Time: 6 Weeks (12 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students make the connection between equivalent ratios and proportional relationships. Students will learn to identify what makes a relationship proportional and how to show proportionality through tables, graphs, equations, and real-world situations.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
7.G.A: Draw, construct, and describe geometrical figures and describe the relationships between them.
7.RP.A: Analyze proportional relationships and use them to solve real-world and mathematical problems.</td><td>● CRITICAL THINKING: Identify a problem, ask key questions and make predictions.
MP #3: Construct viable arguments and critique the reasoning of others.
● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #1 Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Proportional relationships are expressed through equivalent ratios.
● When graphed, a proportional relationship is a straight line through the origin (0,0).
● Relationships may be represented using tables, graphs, equations, and verbal descriptions.
● Some relationships are not proportional.</td><td>● How do we use tables, equations, graphs, and verbal descriptions to identify and describe proportional relationships?
● How are equivalent ratios related to proportional relationships?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
</table>

How to find the constant of proportionality in equivalent ratios, figures, and situations. How to use graphs, tables, equations, and scenarios to compare proportional relationships.	1. I can find the scale factor from information given in a table, equation, graph, or verbal description. 2. I can predict how the constant of proportionality will affect the change in a real-world situation. 3. I can decide if a relationship is proportional or not. 4. I can identify a proportional relationship from a graph, equation, table, and verbal description. 5. I can compare two proportional relationships based on their graphs.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 2 Test: Proportional Relationships

Prealgebra Unit 2 - End of Unit Assessment

1. I can find the constant of proportionality from information given in a table, equation, graph, or verbal description.
TEST Questions: #1, #2, #5
2. I can predict how the constant of proportionality will affect the change in a real-world situation.
TEST Questions: #3
3. I can decide if a relationship is proportional or not.
TEST Questions: #4
4. I can identify a proportional relationship from a graph.
Questions: #4, #5
5. I can compare two proportional relationships based on their graphs, equation, table, and verbal description.
Questions: #6</td><td>Unit 2 Cool Downs

DESMOS Interactive Lessons

Skill Based Whiteboard Activities</td></tr>
<tr><td>Performance Task: Students use proportional reasoning to predict how long it will take someone to run seven miles and consider the meaning of several graph features in context using the Essential Question: How do you use tables, equations, graphs, and verbal descriptions to identify and describe proportional relationships?
● Transfer Skills: Critical Thinking, Self-Direction
● Understandings: #1, 2, 3
● Learning Targets: #2, 5</td><td></td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Find constant of proportionality.	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can find the scale factor from information given in a table, equation, graph, or verbal description. 2. I can predict how the constant of proportionality will affect the change in a real-world situation.	**Essential Questions:** ● How do we use tables, equations, graphs, and verbal descriptions to identify and describe proportional relationships? ● How are equivalent ratios related to proportional relationships?
Learning Activities: 1. Explore equivalent ratios using recipes. 2. Find constant of proportionality with tables. 3. Students compare proportional relationships with equations.	
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Second Unit Topic: Identifying and comparing proportional relationships	**Estimated # of Lessons: 6**
Learning Target(s): 3. I can decide if a relationship is proportional or not. 4. I can identify a proportional relationship from a graph. 5. I can compare two proportional relationships based on their graphs, equation, table, and verbal description.	**Essential Questions:** ● How do we use tables, equations, graphs, and verbal descriptions to identify and describe proportional relationships? ● How are equivalent ratios related to proportional relationships?

Learning Activities: 1. Card sorting to practice identifying relationships that are proportional or not. 2. Online game using trial and error and prediction to explore proportional relationships. 3. Students compare tables and graphs of the same proportional relationship through an online interactive game format.
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COURSE NAME: Prealgebra   Third Unit-Prealgebra IM 4: Percentages & Proportional Relationships
Est. Time: 5 Weeks (12 Lessons, class meets every other day)

OVERVIEW

In this unit, students deepen their understanding of ratios, scale factors, and constants of proportionality (unit rates) by using them to solve multi-step problems that are set in a wide variety of contexts that involve percentages.

STAGE 1 ⟶ IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **7.NS.A**: Apply and extend previous understandings of operations with fractions. **7.RP.A**: Analyze proportional relationships and use them to solve real-world and mathematical problems.	• CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #3: Construct viable arguments and critique the reasoning of others. • SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise. MP #1 Make sense of problems and persevere in solving them. • RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP#4 Model with mathematics.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• A percentage is a ratio with parts per 100. • Computing tax, tip, discount requires converting percentages into equivalent forms such as fractions and decimals. • Increases and decreases in quantities can be expressed as a percentage.	• How do proportions and equivalent fractions relate to percentages? • What is the connection between percent increase and decrease? • How do we use percentages in real-world applications?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to calculate using percentages in a wide variety of situations. How to express changes in amounts using percent increase and decrease.	1. I can find percentages of different quantities. 2. I can solve problems relating to real-world applications. 3. I can find new and original amounts when I am given percent changes.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 Test: Percentages Prealgebra Unit 4 End-of-Unit Assessment 1. I can find percentages of different quantities. TEST QUESTION: #2, #3, #4, #6 2. I can solve problems relating to real-world applications. TEST QUESTION: #2, #3, #4, #6 3. I can find new and original amounts when I am given percent changes. TEST QUESTION: #1, #5, #6	Unit 1 Cool Downs DESMOS Interactive lessons Skill based white board activities
Performance Task: Students will work with a partner to model a business situation where items for sale are marked up or discounted using the Essential Question: What is the connection between percent increase and decrease? How do we use percentages in real-world applications? ● Transfer Skills: Critical Thinking, Self-Direction, Research and Understanding ● Understandings: #1, 2, 3 ● Learning Targets: #1, 2, 3	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Applications of percentages	**Estimated # of Lessons: 5**
Learning Target(s): 1. I can find new and original amounts when I am given percent changes. 2. I can find percentages of different quantities.	**Essential Questions:** ● How do proportions and equivalent fractions relate to percentages? ● What is the connection between percent increase and decrease? ● How do we use percentages in real-world applications?
Learning Activities: 1. Online self-discovery of percent increase and decrease using different shapes. 2. Group work calculating percentages in a variety of situations.	
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Second Unit Topic: Model percentages with mathematics	**Estimated # of Lessons: 5**
Learning Target(s): 3. I can solve problems relating to real-world applications.	**Essential Questions:** ● How do proportions and equivalent fractions relate to percentages? ● What is the connection between percent increase and decrease? ● How do we use percentages in real-world applications?
Learning Activities: 1. Run a restaurant calculating, taxes, tips, and discounts.	

2. Week-long activity comparing tax rates in different states.
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<table>
<tr><td colspan="2">COURSE NAME: Prealgebra Fourth Unit - Prealgebra IM 5: Rational Number Arithmetic
Est. Time: 6 Weeks (12 lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW

In this unit, students will extend their knowledge of addition, subtraction, multiplication, and division of positive whole numbers to include negatives, fractions, and decimals.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDEContent Standards:
7.NS.A: Apply and extend previous understandings of operations with fractions.

7.RP.A: Analyze proportional relationships and use them to solve real-world and mathematical problems.
7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.</td><td>● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.
MP #7: Look for and make use of structure.
● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #1 Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Mathematical operations on signed numbers can be used in real-world situations.
● Mathematical operations are evaluated in a specific order.
● Specific rules apply to different types of rational numbers.</td><td>● Why do we need negative numbers?
● Why do the rules change for mathematical operations when dealing with different types of numbers?
● Why is it necessary to follow the Order of Operations?
● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>Evaluate expressions and solve problems involving positive and negative rational numbers.</td><td>1. I can use a number line to add and subtract positive and negative numbers.
2. I can perform operations on positive and negative numbers.</td></tr>
</table>

How to construct expressions and equations to model real life problems.	3. I can use order of operations to evaluate expressions and solve equations. 4. I can write and solve equations to represent situations that involve rational numbers.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 5 Test: Rational Number Arithmetic
Unit 5 Assessment - Rational Numbers

1. I can use a number line to add and subtract positive and negative numbers.
Test Questions: #2, #3
2. I can perform operations on positive and negative numbers.
Test Questions: #1, #2, #3, #4
3. I can use order of operations to evaluate expressions and solve equations.
Test Questions: #4, #7,
4. I can write and solve equations to represent situations that involve rational numbers.
Test Questions: #5, #6, #7</td><td>Unit 5 Cool Downs

DESMOS Interactive Lessons

Skill Based Whiteboard Activities</td></tr>
<tr><td>• Performance Task: Students will work independently playing a game to send a hot air balloon through a gate using the Essential Question: How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
• Transfer Skills: Critical Thinking, Self-Direction
• Understandings: #1
• Learning Targets: #1, 2</td><td></td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Operations with rational numbers	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can use a number line to add and subtract positive and negative numbers. 2. I can perform operations on positive and negative numbers. 4. I can write and solve equations to represent situations that involve rational numbers.	**Essential Questions:** • Why do we need negative numbers? • Why do the rules change for mathematical operations when dealing with different types of numbers? • Why is it necessary to follow the Order of Operations? • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Practice with temperature scales to identify positive and negative values. 2. Card sorting to match multiple representations of addition and subtraction of negative numbers. 3. Practice combining positive and negative numbers using numbered cards.	
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Second Unit Topic: Representing contexts with equations	**Estimated # of Lessons: 6**
Learning Target(s): 2. I can perform operations on positive and negative numbers. 3. I can use order of operations to evaluate expressions and solve equations. 4. I can write and solve equations to represent situations that involve rational numbers.	**Essential Questions:** • Why do we need negative numbers? • Why do the rules change for mathematical operations when dealing with different types of numbers? • Why is it necessary to follow the Order of Operations? • How can representing the same mathematical relationship in different

	ways allow us to model real-world scenarios and solve problems?

Learning Activities:

1. Explore patterns in multiplication using positive and negative numbers.
2. Online breakout activity to practice order of operations.
3. Creating stories to go with specific equations to help model mathematical situations.

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<table>
<tr><td colspan="2">COURSE NAME: Prealgebra Fifth Unit - Prealgebra IM 6 Expressions, Equations, and Inequalities
Est. Time: 8 Weeks (12 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW

In this unit, students will begin to apply their understanding of rational numbers in the context of equations and inequalities. They will use multiple strategies (hangar diagrams, tape diagrams, etc.) to represent situations with one unknown quantity. They will learn algebraic methods (inverse operations) that model their reasoning for solving equations and inequalities. They will learn proper vocabulary and language as it relates to equations and inequalities.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
7.NS.A: Apply and extend previous understandings of operations with fractions.
7.EE.A: Use properties of operations to generate equivalent expressions.
7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.</td><td>● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.
MP #7: Look for and make use of structure.
● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #1 Make sense of problems and persevere in solving them.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP#5: Use appropriate tools strategically.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● In an equation, a variable represents one number, and any given solution may be checked for precision.
● In an inequality, a variable represents a range of solutions, any of which can be tested for accuracy.
● Equations and inequalities may be used as models to solve real-world problems.
● An inequality is another way to describe a relationship between expressions; instead of showing that the values of two expressions are equal, inequalities indicate that the value of one expression is greater than (or</td><td>● How can we solve multistep equations / inequalities and check that solutions are correct?
● How does the solution to an inequality differ from that of an equation?
● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
</table>

greater than or equal to) the value of the other expression.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
Reason through equations and inequalities to find solutions. Apply inverse operations as a strategy to solve equations and inequalities. How to construct expressions, equations, inequalities to model real life problems.	1. I can find a solution to an equation by reasoning about diagrams or about what value makes the equation true. 2. I can understand what it means for a number to make an equation or an inequality true. 3. I can find an unknow value on a diagram and solve an equation that represents a diagram. 4. I can apply inverse operations to solve equations and inequalities. 5. I can use what I know about equations and inequalities to solve real-world problems.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 Test: Equations and Inequalities Unit 6 Test - Equations and Inequalities 1. I can find a solution to an equation by reasoning about diagrams or about what value makes the equation true. TEST QUESTIONS: #1, #2 2. I can understand what it means for a number to make an equation or an inequality true. TEST QUESTIONS: #4 3. I can find an unknow value on a diagram and solve an equation that represents a diagram. TEST QUESTIONS: #1 4. I can apply inverse operations to solve equations and inequalities. TEST QUESTIONS: #4, #6 5. I can use what I know about equations and inequalities to solve real-world problems. TEST QUESTIONS: #2, #3, #5, #7	Unit 6 Cool Downs DESMOS Interactive Lessons Skill Based Whiteboard Activities

First Unit Topic: Equations	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can find a solution to an equation by reasoning about diagrams or about what value makes the equation true. 2. I can understand what it means for a number to make an equation or an inequality true. 3. I can find an unknow value on a diagram and solve an equation that represents a diagram. 4. I can apply inverse operations to solve equations and inequalities. 5. I can use what I know about equations and inequalities to solve real-world problems.	**Essential Questions:** ● How can we solve multistep equations / inequalities and check that solutions are correct? ● How does the solution to an inequality differ from that of an equation? ● How can representing the same mathematical

	relationship in different ways allow us to model real-world scenarios and solve problems?

Learning Activities:

1. Students use hangar diagrams to model situations involving equations.
2. Students practice keeping hangar diagrams balanced to understand the solution to an equation.
3. Card sorting to match hangar diagrams with equations and solutions.

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Second Unit Topic: Inequalities	**Estimated # of Lessons: 3**
Learning Target(s): 1. I can find a solution to an equation by reasoning about diagrams or about what value makes the equation true. 2. I can understand what it means for a number to make an equation or an inequality true. 3. I can find an unknow value on a diagram and solve an equation that represents a diagram. 4. I can apply inverse operations to solve equations and inequalities. 5. I can use what I know about equations and inequalities to solve real-world problems.	**Essential Questions:** ● How can we solve multistep equations / inequalities and check that solutions are correct? ● How does the solution to an inequality differ from that of an equation? ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?

Learning Activities:

1. Students use online activity to self-discover that an inequality has more than one solution.
2. Students are exposed to real-world situations with inequalities and must reason appropriate constraints to solutions.
3. Students practice in groups with solving inequalities.

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COURSE NAME: Prealgebra **Sixth Unit - Prealgebra IM 8 Probability** **Est. Time: 7 Weeks (5 lessons, class meets every other day)**	
OVERVIEW *In this unit, students will use their understanding of ratios and percentages to calculate probabilities of given events.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **7.RP.A:** Analyze proportional relationships and use them to solve real-world and mathematical problems. **7.SP.C: Investigate** chance processes and develop, use, and evaluate probability models.	• COMMUNICATION: Create a logical and evidenced-based argument to support ideas. MP #3: Construct viable arguments and critique the reasoning of others. • CRITICAL THINKING: identify a problem, ask key questions, and make predictions. MP #4 Model with mathematics
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Probabilities are expressed as fractions, decimals, and percentages. • Probability of all possible outcomes adds to 1 or 100%. • How probability relates to the likelihood of an event (certain, impossible, etc.) • How to calculate independent and dependent probabilities.	• What effects the probability that a given event will occur? • What determines if an event is independent or dependent? • What is the difference between experimental and theoretical probability? • How do we use outcomes to calculate probabilities?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
Express probabilities as fractions, decimals and percents. Describe the likelihood of an event.	1. I can use possible outcomes to calculate the probability of a given event. 2. I can represent a given probability in multiple ways. 3. I can describe the likelihood of events using the words impossible, unlikely, equally likely as not, likely, or certain.

Identify independent and dependent events and calculate their probabilities.	4. I can distinguish between independent and dependent events. 5. I can calculate the probability of independent and dependent events.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 8 Test: Probability Unit 8 Test - Probability 1. I can use possible outcomes to calculate the probability of a given event. TEST QUESTION: #1, #5 2. I can represent a given probability in multiple ways. TEST QUESTION: #2 3. I can describe the likelihood of events using the words impossible, unlikely, equally likely as not, likely, or certain. TEST QUESTION: #3, #4 4. I can distinguish between independent and dependent events. TEST QUESTION: #5 5. I can calculate the probability of independent and dependent events. TEST QUESTION: #5	Unit 1 Cool Downs DESMOS Interactive lessons Skill based white board activities
• **Performance Task:** Students will work collaboratively to calculate probabilities related to a classroom casino the Essential Questions: What effects the probability that a given event will occur? What determines if an event is independent or dependent? • Transfer Skills: Critical Thinking, Communicate • Understandings: #1, 2, 3, 4 • Learning Targets: #1, 2, 3, 4, 5	

First Unit Topic: Theoretical and experimental probabilities	**Estimated # of Lessons: 4**
Learning Target(s): 1. I can use possible outcomes to calculate the probability of a given event. 2. I can represent a given probability in multiple ways. 3. I can describe the likelihood of events using the words impossible, unlikely, equally likely as not, likely, or certain.	**Essential Questions:** • What effects the probability that a given event will occur?

	• What determines if an event is independent or dependent? • What is the difference between experimental and theoretical probability? • How do we use outcomes to calculate probabilities?

Learning Activities:

1. Students patriciate in a whole class activity selecting Starburst candies randomly out of a bag.
2. Online visual activity to guide students in understanding the likelihood of events and how to express probabilities in fractions and percentages.

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Second Unit Topic: Independent and dependent probabilities	**Estimated # of Lessons: 4**
Learning Target(s): 1. I can use possible outcomes to calculate the probability of a given event. 2. I can represent a given probability in multiple ways. 3. I can describe the likelihood of events using the words impossible, unlikely, equally likely as not, likely, or certain. 4. I can distinguish between independent and dependent events. 5. I can calculate the probability of independent and dependent events.	**Essential Questions:** • What effects the probability that a given event will occur? • What determines if an event is independent or dependent? • What is the difference between experimental and theoretical probability? • How do we use outcomes to calculate probabilities?

Learning Activities:

1. Card sort independent and dependent events.
2. Online activity modeling independent vs dependent events using M&Ms.
3. Roulette and blackjack games are played to practice independent and dependent probabilities.

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COURSE NAME: Algebra 1 **First Unit- Algebra 1 IM 1: One-Variable Statistics** **Est. Time: 6 Weeks (16 Lessons, meets every other day)**	
OVERVIEW *In this unit, students will build upon their previous middle school math experience in analyzing data through mean, median, and mode to now include measures of variation (standard deviation, mean absolute deviation). Students will then recognize outliers and determine whether they are a valid datapoint to include in modeling the set. Using a spreadsheet tool, students will enter in and/or construct the appropriate data display.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **S-ID.1**: Represent data with plots on the real number line (dot plots, histograms, and box plots). **S-ID.2**: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. **S-ID.3**: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments. MP #4: Model with mathematics MP #5: Use appropriate tools strategically. ● CRITICAL THINKING: Analyze data in order to draw conclusions. MP #8: Look for and express regularity in repeated reasoning. ● RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information. MP #3: Construct viable arguments.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Understanding variability helps you grasp the likelihood of unusual events. ● A visual display of data is deliberately designed to communicate a message based on the raw data collected.	● How do we make predictions and informed decisions based on current numerical information? How do we handle outliers when they appear in the data? ● What is this data display communicating? To what extent is the data display an accurate representation of the underlying data?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. (FOUNDATIONAL) I can tell the difference between statistical and non-statistical

How to find the best measure of central tendency and measure of variation to represent the data. How to make decisions when faced with the presence of outliers and how they might impact measures of central tendency and variability.	questions and classify data as numerical or categorical. 2. I can calculate summary statistics using technology and interpret the values in context. 3. I can represent and interpret data using data displays and describe distributions using the appropriate terminology *(e.g., symmetric, skewed, uniform, and bell-shaped).* 4. I can compare measures of center and the standard deviation and the interquartile range for different data sets. 5. I can recognize outliers and understand the effect it has on the overall data set. 6. I can investigate the source of outliers and use that to make and justify decisions about excluding them from the data set.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 1 Test: One Variable Statistics

Algebra1-1-End-of-Unit-Assessment-teacher-guide.docx
1. I can tell the difference between statistical and non-statistical questions and classify data as numerical or categorical.
TEST Questions: N/A

2. I can calculate summary statistics using technology and interpret the values in context.
TEST Questions: #5, #6

3. I can represent and interpret data using data displays and describe distributions using the appropriate terminology (e.g., symmetric, skewed, uniform, and bell-shaped).
TEST Questions: #1, #2, #3, #5, #6, #7a

4. I can compare measures of center and the standard deviation and the interquartile range for different data sets.
TEST Questions: #1, #2, #3, #4

5. I can recognize outliers and understand the effect it has on the overall data set.
TEST Questions: #3, #7bd

6. I can investigate the source of outliers and use that to make and justify decisions about excluding them from the data set.
TEST Questions: #7c</td><td>Pre-Assessment:
Algebra 1 Unit 1 Check your Readiness

Ongoing Assessments:
Algebra 1 Unit 1 Cool Downs</td></tr>
<tr><td>Performance Task: Based on contemporary problems, students will be given the context with a related data display and will analyze the data using the Essential Question: What is this data display communicating? To what extent is the data display an accurate representation of the underlying data?
● Transfer Skills: Communication, Critical Thinking, Responsible Citizenship* (depends on the design of data display)
● Understandings: #1, 2
● Learning Targets: #3, 5, 6</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: The Shape of Data and Measures of Central Tendency</td><td>Estimated # of Lessons: 11</td></tr>
<tr><td>Learning Target(s):

1. (FOUNDATIONAL) I can tell the difference between statistical and non-statistical questions and classify data as numerical or categorical.
2. I can calculate summary statistics using technology and interpret the values in context.

3. I can represent and interpret data using data displays and describe distributions using the appropriate terminology (e.g., symmetric, skewed, uniform, and bell-shaped).

4. I can compare measures of center and the standard deviation and the interquartile range for different data sets.</td><td>Essential Questions:

● How do we make predictions and informed decisions based on current numerical information?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Constructing frequency tables and histograms from raw data and then calculating the five-number summary in order to draw a box plot.
2. Given a set of dot plots and histograms, the student will identify the appropriate histogram to the corresponding dot plot, describe the shape of the data, and then create a statistical question that matches the shape of the data.
3. Analyzing raw data using Excel to calculate measures of central tendency, quartiles, interquartile range, and range.
4. Using Excel, the effect of extremes on the shape of a histogram will be explored by allowing students to type in different data values and watching the shape of the histogram change.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

<table>
<tr><td>Second Unit Topic: Measures of Variation and Outliers</td><td>Estimated # of Lessons: 5</td></tr>
<tr><td>Learning Target(s):</td><td>Essential Questions:</td></tr>
</table>

5. I can recognize outliers and understand the effect it has on the overall data set. 6. I can investigate the source of outliers and use that to make and justify decisions about excluding them from the data set.	• How do we handle outliers when they appear in the data? • What is this data display communicating? To what extent is the data display an accurate representation of the underlying data?
Learning Activities: 1. Excel will be utilized to calculate the standard deviation of a data set and then values will be removed or added to the data set allowing students to decipher the effect of that removal or addition on the standard deviation, mean, median, and interquartile range. 2. The shape of a data set will be analyzed to determine which measures of central tendency and variation are most appropriate to describe the data.	
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COURSE NAME: Algebra 1 Second Unit- Algebra 1 IM 2: Linear Equations, Inequalities and Systems Est. Time: 10 Weeks (26 Lessons, meets every other day)	
OVERVIEW *In this unit, students will build upon their previous middle school math experience of understanding how variables, expressions, equations, and inequalities could be used to represent quantities and relationships. Students further develop their capacity to solve real world problems through the analysis of equations and inequalities in different formats.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSA-REI.A:** Understand solving equations as a process of reasoning and explain the reasoning. **HSA-REI.B**: Solve equations and inequalities in one variable. **HSA-REI.C:** Solve systems of equations. **HSA-REI.D:** Represent and solve equations and inequalities graphically. **HSA-CED.A:** Create equations that describe numbers or relationships.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Realistic solutions to equations or inequalities require understanding of what the real-world scenario looks like regardless of the form (i.e., table, graph, or algebraically) ● Leveraging technology to demonstrate the relationship between equations and inequalities creates a dynamic representation of the real-world scenario for further possibilities.	● How do we construct and solve equations and inequalities to make sense of real-world problems? ● What does the equation or inequality look like on the graph? How does that reveal possible solutions to the real-world problem?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to construct and solve equations and systems of equations to model real life problems. How to construct inequalities and systems of inequalities to model real life problems.	1. I can construct and solve equations and look for values that satisfy the constraints and make the equations true. 2. I can investigate different ways to express the same relationship or constraint by analyzing and writing equivalent equations. 3. I can explore how the form and the parts of a linear equation in two variables are related to the features of its graph. 4. I can solve systems of equations by elimination and substitution explaining why the steps taken to eliminate the variable are valid and productive. 5. I can verify that a solution to an inequality in one or two variables is a value or a pair of values that makes the inequality true. 6. I can verify that a solution to a system of inequalities in two variables is any pair of values that make both inequalities in the system true. 7. I can construct and solve inequalities and look for values that satisfy the constraints and make the inequalities true.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 2 Mid-Assessment: Equations
Algebra 2 Mid-Assessment
1. I can construct and solve equations and look for values that satisfy the constraints and make the equations true.
TEST Question: #3, #4

2. I can investigate different ways to express the same relationship or constraint-by analyzing and writing equivalent equations.
TEST Questions: #1, #2, #7

3. I can explore how the form and the parts of a linear equation in two variables are related to the features of its graph.
TEST Question: #3, #5

4. I can solve systems of equations by elimination and substitution explaining why the steps taken to eliminate the variable are valid and productive.
TEST Questions: #6, #7

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5. I can see that a solution to an inequality in one or two variables is a value or a pair of values that makes the inequality true.
TEST Questions: #1, #2, #4. #6

6. I can see that a solution to a system of inequalities in two variables is any pair of values that make both inequalities in the system true.
TEST Questions: #1, #3, #5, #7

7. I can construct and solve inequalities and look for values that satisfy the constraints and make the inequalities true.
TEST Questions: #6, #7</td><td>Pre- Assessment:
Algebra 1 Unit 2 Check your Readiness

Algebra1-2-Check-Your-Readiness-teacher-guide

Ongoing Assessments:
Algebra 1 Unit 2 Cool Downs

Algebra 1 Unit 2 Quizzes</td></tr>
<tr><td>● Performance Task: Based on a nutritional chart for trail mix ingredients, students will be given constraints and a graph of a system of inequalities involving two of the ingredients where students must use the chart and the graph to identify which two ingredients are being used to answer the Essential Question: How do we construct</td><td></td></tr>
</table>

and solve equations and inequalities to make sense of real-world problems? ● Transfer Skills: Communication and Critical Thinking ● Understandings: #1 ● Learning Targets: #5, 6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Equations and Systems of Equations.	**Estimated # of Lessons: 17**
1. I can construct and solve equations and look for values that satisfy the constraints and make the equations true. 2. I can investigate different ways to express the same relationship or constraint-by analyzing and writing equivalent equations. 3. I can explore how the form and the parts of a linear equation in two variables are related to the features of its graph. 4. I can solve systems of equations by elimination and substitution explaining why the steps taken to eliminate the variable are valid and productive.	**Essential Questions:** How do we construct and solve equations and inequalities to solve real life problems? What does the equation or inequality look like on the graph? What does that communicate to us in terms of the real-world problem?
Learning Activities: 1. Construct equations that describe relationships and constraints. 2. Given a linear equation solve for the correct solution and provide an explanation of what the solution means. 3. Graph equations in two variables. 4. Given an equation, rewrite the equation in different forms while maintaining the original solution. 5. Given a system of equations, solve the system graphically or by using substitution or elimination.	
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<table>
<tr><td>Second Unit Topic: Inequalities and Systems of Inequalities</td><td>Estimated # of Lessons: 9</td></tr>
<tr><td>Learning Target(s):
6. I can see that a solution to an inequality in one or two variables is a value or a pair of values that makes the inequality true.
7. I can see that a solution to a system of inequalities in two variables is any pair of values that make both inequalities in the system true.
8. I can construct and solve inequalities and look for values that satisfy the constraints and make the inequalities true.</td><td>Essential Questions:
● How do we construct and solve equations and inequalities to solve real life problems?
● What does the equation or inequality look like on the graph? What does that communicate to us in terms of the real-world problem?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Construct inequalities that describe relationships and constraints.
2. Given a linear inequality, solve for the correct solution and provide an explanation of what the solution means.
3. Graph inequalities in two variables.
4. Given a system of inequalities, solve the system graphically.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

COURSE NAME: Algebra 1 3rd Unit- Algebra 1 IM 4: Functions Est. Time: 6 Weeks (18 Lessons, meets every other day)	
OVERVIEW *In this unit, students expand their understanding of functions building on their previous middle school math experience. Students will continue to examine functions from a graphical perspective and through modeling real world data.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF-IF.A:** Understand the concept of a function and use function notation. **HSF-IF.B:** Interpret functions that arise in applications in terms of the context. **HSF-IF.C:** Analyze functions using different representations. **HSF-BF.A:** Build a function that models a relationship between two quantities. **HSF-BF.B:** Build new functions from existing functions. **HSA-REI.A:** Understand solving equations as a process of reasoning and explain the reasoning. **HSA-REI.D:** Represent and solve equations and inequalities graphically. **HSS-ID.B:** Summarize, represent, and interpret data on two categorical and quantitative variables **HSA-CED.A:** Create equations that describe numbers or relationships.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #8: Look for and express regularity in repeated reasoning.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Modeling of real-world scenarios, with the use of a function, allows for predictions to be made in the past or in the future.	● How are functions defined to model and predict behavior of real- world scenarios?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to construct the model of a function so that predictions can be made by evaluating the function.	1. (Foundational) I can explain when a relationship between two quantities is a function. 2. I can use function notation to express functions that have specific inputs and outputs. 3. I can use function notation to efficiently represent a relationship between two quantities in a situation. 4. I can estimate or calculate the average rate of change between two points. 5. I can determine a reasonable domain and range for a function. 6. I can make sense of the rules of a piecewise function when they are written in function notation and explain what they mean in the situation represented. 7. I can find the inverse of a function and explain what that inverse means. 8. I can model data to develop a linear function and then its inverse.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>•</td><td></td></tr>
<tr><td>Unit 4 Mid-Assessment: Functions

Algebra 1-4-Mid-Unit-Assessment-teacher-guide

1. I can explain when a relationship between two quantities is a function.
Test Questions: N/A

2. I can use function notation to express functions that have specific inputs and outputs.
Test Questions: #1, #2, #4, #6

3. I can use function notation to efficiently represent a relationship between two quantities in a situation.
Test Questions: #2, #3, #5, #6

4. I can estimate or calculate the average rate of change between two points.
Test Questions: #7

Algebra 1-4-End-of-Unit-Assessment-teacher-guide

5. I can determine a reasonable domain and range for a function.
Test Questions: #1, #7

6. I can make sense of the rules of a piecewise function when they are written in function notation and explain what they mean in the situation represented.
Test Questions: #2, #3, #5, #7

7. I can use words and equations to describe the inverse function.
Test Questions: #4, #6</td><td>Pre- Assessment:

Algebra 1-4-Check-Your-Readiness -teacher-guide

Algebra 1 Unit 4 Check Your Readiness

Ongoing Assessments: Unit 4 Cool Downs

Algebra 1 Unit 4 Quizzes</td></tr>
<tr><td>• Performance Task: Students will examine the charging patterns of a device they own (phone, computer, etc…). They will then examine data obtained from a fictional phone to construct linear functions that model the phone's battery behavior using the Essential Question: What is a function and how are functions defined to model and predict behavior of real- world scenarios?</td><td></td></tr>
</table>

· Transfer Skills: Critical Thinking · Understandings: #1 · Learning Targets: #2, 3, 4, 8	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Functions and Average Rate of Change.	**Estimated # of Lessons: 9**
1. (Foundational) I can explain when a relationship between two quantities is a function. 2. I can use function notation to express functions that have specific inputs and outputs. 3. I can use function notation to efficiently represent a relationship between two quantities in a situation. 4. I can estimate or calculate the average rate of change between two points.	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real-world scenarios?
Learning Activities: 1. Graph a function given time as independent variable and distance as dependent variable. 2. Given a graph of a function, be able to answer questions which are given in function notation. 3. Given a square, fill out tables concerning the area and perimeter of the square. Then using the tables write a rule for each function and graph the function. 4. Given two functions representing data plans for two phones, determine which data plan should be chosen given a student's budget. 5. Given a graph of the population of two states, the states will be compared using the average rate of change between years. 6. Given a video of a flag being raised, a graph of time vs. height will be drawn and the average rate of change calculated between two prescribed times.	
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Second Unit Topic: Domain, Range, and Inverse Functions.	Estimated # of Lessons: 9
Learning Target(s): 5. I can determine a reasonable domain and range for a function. 6. I can make sense of the rules of a piecewise function when they are written in function notation and explain what they mean in the situation represented. 7. I can use words and equations to describe the inverse function. 8. I can write a linear function to model data and find the inverse of the function.	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real- world scenarios?

Learning Activities:

1. Given three different scenarios and a list of inputs, the inputs will be divided into two categories: possible inputs or impossible inputs.
2. Given a graph of a bouncing ball, the domain and range of the graph will be determined.
3. Given a piecewise function representing the cost of renting a bike, a table and graph representing the function will be constructed.
4. Given the functions $f(x) = |x + a|$ and $f(x) = |x| + b$, the effect that a and b have on the graph will be discovered.
5. Given plain text and cipher text, an inverse function will be created to decipher a code.

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COURSE NAME: Algebra 1 Fourth Unit- Algebra 1 IM 5: Exponentials Est. Time: 7 Weeks (21 Lessons, meets every other day)	
OVERVIEW *In this unit, students will use their understanding of exponential growth and decay to build models representing real world phenomena and make predictions using these models.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF-LE.A:** Construct and compare linear, quadratic, and exponential models and solve problems. **HSF-LE.B:** Interpret expressions for functions in terms of the situation they model. **HSA-SSE.A:** Interpret the structure of expressions. **HSA-CED.A:** Create equations that describe numbers or relationships. **HSF-IF.B:** Interpret functions that arise in applications in terms of the context. **HSF-IF.C:** Analyze functions using different representations.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #8: Look for and express regularity in repeated reasoning.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Modeling of real-world scenarios, with the use of a function, allows for predictions to be made in the past or in the future.	● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to construct the model of an exponential function so that predictions can be made by evaluating the function.	1. I can compare growth patterns using calculations and graphs. 2. I can write and interpret an equation that represents exponential growth or decay. 3. I can write and graph an equation that represents exponential growth or decay to solve problems. 4. I can explain the meanings of *a* and *b* in an equation that represents exponential growth or decay and is written as $y = a{\cdot}b^x$. 5. I know how the average rate of change of an exponential function differs from that of a linear function. 6. I can use exponential functions to model situations that involve exponential growth or decay. 7. I can find the result of applying a percent increase or decrease on a quantity. 8. I can calculate interest when I know the starting balance, interest rate, and compounding intervals.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Algebra 1-5-Mid-Unit-Assessment-teacher-guide 1. I can compare growth patterns using calculations and graphs. Test Questions: #1 2. I can write and interpret an equation that represents exponential growth or decay. Test Questions: #2, #4, #5, #6 3. I can write and graph an equation that represents exponential growth or decay to solve problems. Test Questions: #3, #6, #7 4. I can explain the meanings of *a* and *b* in an equation that represents exponential growth or decay and is written as $y = a \cdot b^x$. Test Questions: #2, #4, #5, #6, #7 Algebra 1-5-End-of-Unit-Assessment-teacher-guide 5. I know how the average rate of change of an exponential function differs from that of a linear function. Test Questions: #7 6. I can use exponential functions to model situations that involve exponential growth or decay. Test Questions: #1, #2, #4, #6 7. I can find the result of applying a percent increase or decrease on a quantity. Test Questions: #1, #2, #3, #5 8. I can calculate interest when I know the starting balance, interest rate, and compounding intervals. Test Questions: #4, #7	Pre- Assessment: Algebra 1-5-Check-Your-Readiness-teacher-guide Algebra 1 Unit 5 Check Your Readiness Ongoing Assessments: Algebra 1 Unit 5 quizzes Unit 5 Cool Downs
• **Performance Task:** Students will be given the population of Paris, Austin, and Chicago from 1950 to 2000. Using this data, students will need to decide if the population can be modeled using a linear or exponential function. Students must then create a function modeling the population change, graph the function, compare the results of	

the function to the actual population, and then make predictions for the population in the years 2010 and 2050. This task answers the Essential Question: What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? · Transfer Skills: Critical Thinking · Understandings: #1 · Learning Targets: #1, 2, 3, 5, 6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponential Growth and Decay.	**Estimated # of Lessons: 13**
1. I can compare growth patterns using calculations and graphs. 2. I can write and interpret an equation that represents exponential growth or decay. 3. I can write and graph an equation that represents exponential growth or decay to solve problems. 4. I can explain the meanings of *a* and *b* in an equation that represents exponential growth or decay and is written as $y = a \cdot b^x$.	**Essential Questions:** ● What is an exponential function and how are exponential functions defined to model and predict behavior of real-world scenarios?

Learning Activities:

1. Use Excel to determine the difference between succeeding values in a table to determine whether growth is linear or exponential.
2. Given an incomplete table of values, determine what 3^0 and 3^{-x} represent.
3. Given the initial value of a vehicle and the fraction of its value it loses each year, determine an equation that models the vehicle's value.
4. Given an equation which represents the area covered by algae, create a graph to represent the area covered for the first 4 weeks.

5. Given a scenario where the amount of coral doubles each year, be able to model the growth with an equation and determine how much coral there was in previous years using negative exponents. 6. Given a table of the number of coffee shops opened over a 10 year period, determine the average rate of change over multiple year intervals. 7. Use Desmos to determine how changing the value of *a* and then the value of *b* effect the graphs of exponential functions. 8. Given two points on the graph of an exponential function, determine the equation of the function.
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Second Unit Topic: Percent Change and Compound Interest.	**Estimated # of Lessons: 8**
Learning Target(s): 5. I know how the average rate of change of an exponential function differs from that of a linear function. 6. I can use exponential functions to model situations that involve exponential growth or decay. 7. I can find the result of applying a percent increase or decrease on a quantity. 8. I can calculate interest when I know the starting balance, interest rate, and compounding intervals.	**Essential Questions:** ● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios?
Learning Activities: 1. Given different scenarios involving percent increase or decrease, calculate the final cost of the product. 2. Given an initial balance and monthly interest rate, determine the amount in a bank account after several different time periods. 3. Given a credit card balance and an annual interest rate compounded monthly, determine the effective annual interest rate.	

4. Given a table of values for simple interest and compound interest, derive equations that model both situations.
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 First Unit - Algebra 1 IM Unit 6: Quadratic Functions
Est. Time: 6 Weeks (14 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will look at and compare different number patterns. Specifically, these will include linear, exponential, and quadratic patterns. Students will interpret, represent, and analyze quadratic functions algebraically, graphically, and in tables. Students will see how expressions in standard, factored, and vertex form reveal important behavior and features of quadratic relationships. Students will study a variety of real-world problems that can be analyzed with quadratic functions.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSA-SSE.A: Interpret the structure of expressions.
HSA-SSE.B: Write expressions in equivalent forms to solve problems.
HSF-BF.A: Build a function that models a relationship between two quantities.
HSF-BF.B: Build new functions from existing functions.
HSF-IF.A: Understand the concept of a function and use function notation.
HSF-IF.B: Interpret functions that arise in applications in terms of the context.
HSF-IF.C: Analyze functions using different representations.
HSF-LE.A: Construct and compare linear, quadratic, and exponential models and solve problems.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #3: Construct viable arguments
MP #5: Use appropriate tools strategically.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #8: Look for and express regularity in repeated reasoning.
● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.
MP #2: Reason abstractly and quantitatively.
MP #4: Model with mathematics.
● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Functions often have different forms that describe the same situation, but specific forms are more efficient at answering certain questions.</td><td>● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?</td></tr>
</table>

• Many real-world situations can be modeled or approximated using quadratic functions.	• How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to determine that quadratic relationships involving x^2 change differently than linear relationships. How to decipher the difference between factored form, standard form, and vertex form, and when they are useful.	1. (FOUNDATIONAL) I can identify, compare, and contrast quadratic, linear, and exponential patterns. 2. I can write and interpret a quadratic expression that represents a situation. 3. I can rewrite factored form as standard form. 4. I can identify key graph features (intercepts, vertex, max/min) when given quadratics in different forms. 5. I can explain how changing the a, b, and c values in a quadratic equation $y = ax^2 + bx + c$ affects the graph. 6. I can explain how changing the a, h, and k values in a quadratic equation $y = a(x - h)^2 + k$ affects the graph.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 Test: Quadratic Functions Unit 6 Test.docx 1. (FOUNDATIONAL) I can identify, compare, and contrast quadratic, linear, and exponential patterns. 2. I can write and interpret a quadratic expression that represents a situation. TEST Question: #6 3. I can rewrite factored form as standard form. TEST Questions: #3, #4, #6 4. I can identify key graph features (intercepts, vertex, max/min) when given quadratics in different forms. TEST Questions: #1, #2, #3, #5, #6 5. I can explain how changing the a, b, and c values in a quadratic equation $y = ax^2 + bx + c$ affects the graph. TEST Questions: #4, #5 6. I can explain how changing the a, h, and k values in a quadratic equation $y = a(x - h)^2 + k$ affects the graph. TEST Questions: #2, #4	Pre- Assessment: Algebra 1 Unit 6 Check-Your-Readiness Ongoing Assessments: Algebra 1 Unit 6 Cool Downs Algebra 1 Unit 6 Quizzes
Performance Task: Students will draw a trophy using graphing technology by applying the skills and knowledge of the unit regarding features of quadratic functions and considering the Essential Question: How does the equation of a function provide us information about the relationship between its inputs and outputs? ● Transfer Skills: Critical Thinking, Self Direction ● Understandings: #1 ● Learning Targets: #4, 5, 6	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION

<table>
<tr><td>First Unit Topic: Quadratic Expressions and Functions</td><td>Estimated # of Lessons: 7</td></tr>
<tr><td>Learning Target(s):
1. (FOUNDATIONAL) I can identify, compare, and contrast quadratic, linear, and exponential patterns.
2. I can write and interpret a quadratic expression that represents a situation.
3. I can rewrite factored form as standard form.</td><td>Essential Questions:
• How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?
• How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Use tables of values in context to identify and explore a new kind of relationship (quadratic) between inputs and outputs.
2. Analyze objects in trajectory problems to explore an application of quadratic functions and the connections between the functions and parameters in the situation.
3. Use area diagrams to explore distributing and converting factored form into standard form.
4. Begin making connections between standard form, factored form, and graphs of quadratic functions through a matching activity.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

<table>
<tr><td>Second Unit Topic: Features of Graphs of Quadratic Functions</td><td>Estimated # of Lessons: 7</td></tr>
<tr><td>Learning Target(s):
4. I can identify key graph features (intercepts, vertex, max/min) when given quadratics in different forms.</td><td>Essential Questions:
• How does the equation of a function provide us information about the relationship between its inputs and outputs? How</td></tr>
</table>

5. I can explain how changing the $a,\ b$, and c values in a quadratic equation $y = ax^2 + bx + c$ affects the graph. 6. I can explain how changing the $a,\ h$, and k values in a quadratic equation $y = a(x - h)^2 + k$ affects the graph.	are new functions connected to functions I am already familiar with? • How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?

Learning Activities:

1. Use tables of values to locate x-intercepts and the vertex. Then formalize the connections between factored form, the x-intercepts, and the vertex.
2. Use graphing technology (Desmos) to explore how the different coefficients in standard form affect the graph of the function. Solidify these connections in a matching activity.
3. Given a graph, practice writing equations that would have the same key graph features.
4. Use graphing technology (Desmos) to explore how the parameters in vertex form affect the graph of the function. Solidify these connections in a matching activity.
5. Develop an equation that will result in a trajectory that allows a peanut to jump over a wall. Use graphing technology to help.

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COURSE NAME: Algebra 2 Second Unit - Algebra 1 IM Unit 7: Quadratic Equations Est. Time: 7 Weeks (24 Lessons, meets every other day)	
OVERVIEW *In this unit, students will write, interpret, and solve quadratic equations. Students will use quadratic equations to model real-world situations and solve problems. Students will learn a variety of ways to solve quadratic equations, including using basic algebraic reasoning, graphing, factoring, completing the square, and the quadratic formula. They will see that certain strategies are more effective in different situations. At the end of the unit, students will bring together the new material of this unit and the content from Unit 6 to fully and precisely analyze situations involving quadratic functions.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSA-SSE.A:** Interpret the structure of expressions. **HSA-SSE.B:** Write expressions in equivalent forms to solve problems. **HSA-REI.B:** Solve equations and inequalities in one variable. **HSN-RN.B:** Use properties of rational and irrational numbers. **HSA-CED.A:** Create equations that describe numbers or relationships.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments and critique reasoning of others MP #5: Use appropriate tools strategically. ● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #8: Look for and express regularity in repeated reasoning. ● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #2: Reason abstractly and quantitatively. MP #4: Model with mathematics. ● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Functions often have different forms that describe the same situation, but specific forms are more efficient at answering	● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions

certain questions. ● Many real-world situations can be modeled or approximated using quadratic functions.	connected to functions I am already familiar with? ● How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to solve quadratic equations using multiple strategies. In different situations, different strategies may be more efficient. How to determine if quadratic equations have 0, 1, or 2 real-number solutions and whether these solutions are rational or irrational numbers.	1. I can solve quadratic equations using algebraic reasoning. 2. I can use a graph to identify the solutions of a quadratic equation. 3. I can rewrite a quadratic expression in factored form and use factored form to help solve a quadratic equation. 4. I can complete the square and use this strategy to solve quadratic equations. 5. I can use the quadratic formula to solve quadratic equations. 6. I can write quadratic equations to model situations and solve problems. 7. I can determine if the solutions to a quadratic equation are rational or irrational.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 Test: Quadratic Equations Unit 7 Mid-Unit Test: Quadratic Equations 1. I can solve quadratic equations using algebraic reasoning. TEST Questions: #1, #5, #6 2. I can use a graph to identify the solutions of a quadratic equation. TEST Question: #2 3. I can rewrite a quadratic expression in factored form and use factored form to help solve a quadratic equation. TEST Questions: #3, #4, #5, #6 6. I can write quadratic equations to model situations and solve problems. TEST Questions: #7 Unit 7 End-of-Unit Test: Quadratic Equations 4. I can complete the square and use this strategy to solve quadratic equations. TEST Questions: #1, #5 5. I can use the quadratic formula to solve quadratic equations. TEST Questions: #2, #9 6. I can write quadratic equations to model situations and solve problems. TEST Question: #3 7. I can determine if the solutions to a quadratic equation are rational or irrational. TEST Question: #4	Pre- Assessment: Algebra 1 Unit 7 Check-Your-Readiness Ongoing Assessments: Algebra 1 Unit 7 Cool Downs Algebra 1 Unit 7 Quizzes

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Solving Quadratic Equations	**Estimated # of Lessons: 9**

Learning Target(s):	Essential Questions:
1. I can solve quadratic equations using algebraic reasoning. 2. I can use a graph to identify the solutions of a quadratic equation. 3. I can rewrite a quadratic expression in factored form and use factored form to help solve a quadratic equation. 6. I can write quadratic equations to model situations and solve problems.	• How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? • How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
Learning Activities: 1. Attempt to solve several quadratic equations in context and notice that some can be solved using algebra skills they already have, while others cannot. 2. Notice while solving sample quadratic equations that many have 2 solutions, while others only have 1 or 0 real solutions. 3. Observe that factored form can be useful for solving quadratic equations and will gradually develop a strategy for factoring. 4. Identify factoring patterns that allow for shortcuts when factoring certain types of quadratic expressions.	
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Second Unit Topic: Features of Graphs of Quadratic Functions	**Estimated # of Lessons: 7**
Learning Target(s):	**Essential Questions:**

4. I can complete the square and use this strategy to solve quadratic equations. 5. I can use the quadratic formula to solve quadratic equations. 6. I can write quadratic equations to model situations and solve problems. 7. I can determine if the solutions to a quadratic equation are rational or irrational.	• How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? • How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
Learning Activities: 1. Recall what a perfect square is, then observe that quadratic equations can often be rewritten as the square of a linear factor. 2. Introduce the quadratic formula as a potential strategy for solving quadratic equations, then practice using it. 3. Derive the quadratic formula by completing the square for a general quadratic equation. 4. Convert between exact notations and decimal approximations for irrational solutions. Determine what makes a solution irrational. 5. Model quadratic scenarios with functions. Use these functions to find the zeros, maximum/minimum value, and other important points related to the situation.	
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Third Unit - Algebra 1 IM Unit 4: Exponential Functions and Equations
Est. Time: 7 Weeks (14 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will work with exponential relationships in the context of real-world problems and represent them with equations, tables, and graphs.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSF-LE.A: Construct and compare linear, quadratic, and exponential models and solve problems.
HSF-LE.B: Interpret expressions for functions in terms of the situation they model.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #2: Reason abstractly and quantitatively.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Exponential functions can be used to model situations in which a quantity changes by a constant factor and these functions can be represented in a variety of ways (table, graph, equations).
● Technology can be a good way to find an approximate solution to an exponential equation, but logarithms are necessary for finding exact solutions to some exponential problems.
● Logarithms can be used to model situations directly, in addition to as a tool for solving exponential equations.</td><td>● What is an exponential function and how are exponential functions utilized to model and predict behavior of real- world scenarios?
● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
</table>

How to recognize exponential situations in real-world contexts and use equations to model them. How to reason that exponential and logarithmic representations are connected and can be useful in different situations.	1. I can determine the growth/decay factor and rate for an exponential situation. 2. I can use exponential equations to make predictions in real-world contexts. 3. I can interpret exponential equations in context. 4. I can write exponential equations when given information in a word problem, table, or graph. 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs. 6. I can solve exponential equations using logarithms. 7. I can convert between exponential and logarithmic form. 8. I can interpret logarithmic functions in context. 9. I can evaluate logarithms.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 Mid-Unit Assessment: Exponential Functions Unit 4 Mid-Unit Assessment 1. I can determine the growth/decay factor and rate for an exponential situation. TEST Question: #1, #3, #6, #7 2. I can use exponential equations to make predictions in real-world contexts. TEST Question: #4, #5, #6 3. I can interpret exponential equations in context. TEST Question: #2, #6 4. I can write exponential equations when given information in a word problem, table, or graph. TEST Question: #3, #4, #5, #7 Unit 4 End of Unit Assessment: Exponential and Logarithmic Functions Unit 4 End-of-Unit Assessment 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs. TEST Question: #1, #5, #7 6. I can solve exponential equations using logarithms. TEST Question: #2, #3, #5, #6, #7 7. I can convert between exponential and logarithmic form. TEST Question: #2 8. I can interpret logarithmic functions in context. TEST Question: #4 9. I can evaluate logarithms. TEST Question: #1, #2, #4	Pre- Assessment: Algebra 2 Unit 4 Check Your Readiness Ongoing Assessments: Algebra 2 Unit 4 Cooldowns Algebra 2 Unit 4 Quizzes
Performance Task: Students will be introduced to two new real-world situations, pH and the Richter scale, in which an exponential/logarithmic	

relationship is evident, but the exact model is not immediately obvious. Students will then work to develop functions that can model these situations, addressing the Essential Question: What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? • Transfer Skills: Synthesize information to solve problems and defend claims. • Understandings: #3 • Learning Targets: #7, #8, #9	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponential Functions/Growth and Decay	**Estimated # of Lessons: 9**
Learning Target(s): 1. I can determine the growth/decay factor and rate for an exponential situation. 2. I can use exponential equations to make predictions in real-world contexts. 3. I can interpret exponential equations in context. 4. I can write exponential equations when given information in a word problem, table, or graph. 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs.	**Essential Questions:** • What is a function and how are functions defined to model and predict behavior of real- world scenarios? • What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Analyze situations involving exponential growth or decay by identifying the growth/decay factor and noticing that exponents can be used to simplify computation. 2. Practice representing exponential situations using functions. Use these functions to make predictions about the situation. 3. Analyze exponential situations involving rational inputs (including negative values). Explain what these inputs and corresponding outputs represent in context. 4. Find missing exponent values using graphs and guess-and-check.	
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<table>
<tr><th>Second Unit Topic: Logarithms</th><th>Estimated # of Lessons: 5</th></tr>
<tr><td>Learning Target(s):

6. I can solve exponential equations using logarithms.

7. I can convert between exponential and logarithmic form.

8. I can interpret logarithmic functions in context.

9. I can evaluate logarithms.</td><td>Essential Questions:

● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios?

● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Use a logarithm table to begin considering what a logarithm is.
2. Practice converting between logarithmic and exponential form.
3. Explore the scenario where a value grows by a tiny amount many times and use this to introduce the number e.
4. Investigate model sample problems to introduce solving exponential equations using logarithms.
5. Model situations using logarithms and consider how to connect these models to exponential situations.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Fourth Unit - Algebra 2 IM Unit 2: Polynomials and Rational Functions
Est. Time: 8 Weeks (26 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will expand their understanding of functions to include the family of functions known as polynomials. Previously, students have worked with linear and quadratic functions, which are part of this family. They will analyze the connections between the equations and graphs of polynomials and look at contexts that can be modeled with polynomials. Later in this unit, students will investigate rational functions, which are made by dividing two polynomials.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSA.APR.A: Perform arithmetic operations on polynomials.
HSA.APR.B: Understand the relationship between zeros and factors of polynomials.
HSA.APR.C: Use polynomial identities to solve problems.
HSA.APR.D: Rewrite rational expressions.
HSA.CED.A: Create equations that describe numbers or relationships.
HSA.REI.A: Understand solving equations as a process of reasoning and explain the reasoning.
HSA.REI.C: Solve systems of equations.
HSA.REI.D: Represent and solve equations and inequalities graphically.
HSA.SSE.B: Write expressions in equivalent forms to solve problems.
HSF.IF.B: Interpret functions that arise in applications in terms of the context.
HSF.IF.C: Analyze functions using different representations.</td><td>● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.

MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Polynomials and rational functions can be used to model a wide variety of real-world scenarios.</td><td>● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?

● What are some of the strategies we can use to find an unknown quantity and what</td></tr>
</table>

	are the advantages and disadvantages of these different strategies?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to recognize polynomial functions as a general family of functions that include quadratics and understand rational functions as a result of the division of polynomial functions.	1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations. 7. I can solve rational equations.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Mid-Test: Polynomials and Rational Functions Algebra 2 Unit 2 Mid-Unit Test 1. I can write equivalent expressions for polynomial and rational expressions. Test Question: #1, #5	Pre- Assessment: Algebra 2-2-Check-Your-Readiness-teacher-guide Unit 1 Check Your Readiness Assessment

2. I can determine the zeros and factors of a polynomial function from the equation or graph. Test Question: #2, #5, #6 3. I can determine the points of intersection of polynomial functions. Test Question: #3 4. I can sketch a graph of a polynomial function when given the equation of the function. Test Question: #7 5. I can analyze key graph features of polynomials and rational functions. Test Question: #4, #7 6. I can write and analyze polynomial and rational expressions to represent real-world situations. Test Question: #4 Unit 2 End of Unit Test: Polynomials and Rational Functions Algebra 2 Unit 2 End-of-Unit Test 1. I can write equivalent expressions for polynomial and rational expressions. Test Question: #1, #5 2. I can determine the zeros of a polynomial function from the equation or graph. Test Question: #3 5. I can analyze key graph features of polynomials and rational functions. Test Question: #3 6. I can write and analyze polynomial and rational expressions to represent real-world situations. Test Question: #2, #6, #7 7. I can solve rational equations. Test Question: #4	Ongoing Assessments: Algebra 2 Unit 2 Cool Downs Algebra 2 Unit 2 Quizzes

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Polynomials	**Estimated # of Lessons: 13**
Learning Target(s): 1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?

3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations.	● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Consider the scenario of trying to maximize the volume of a box as an introduction to polynomial expressions. 2. Use graphing technology to observe a pattern between the factored form of a polynomial and its zeros. 3. Use graphing technology to begin analyzing end behavior and multiplicity of polynomials. 4. Use application problems as an introduction to dividing polynomial functions.	
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Second Unit Topic: Rational Functions	**Estimated # of Lessons: 13**
Learning Target(s): 1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations. 7. I can solve rational equations.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?

Learning Activities: 1. Use additional application problems to begin modeling using division of polynomial functions, then transition this understanding into rational functions. 2. Use graphing technology to help analyze key graph features of rational functions. 3. Look at completed sample problems to being exploring useful strategies for solving rational equations.
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COURSE NAME: Algebra 2 Fifth Unit - Algebra 2 IM Unit 1 - Sequences and Functions **Est. Time: 6 Weeks (11 Lessons, meets every other day)**	
OVERVIEW *In this unit, students will continue to examine functions from Algebra I by extending into geometric and arithmetic sequences which reinforces the concepts of exponential and linear functions.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF-IF.A:** Understand the concept of a function and use function notation. **HSF-IF.C:** Analyze functions using different representations.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #8: Look for and express regularity in repeated reasoning.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Modeling of real-world scenarios, with the use of sequences, allows for predictions to be made in the past or in the future. ● Different situations are modeled better by arithmetic or geometric sequences.	● What is a function and how are functions defined to model and predict behavior of real- world scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to construct the model of a sequence so that predictions can be made by evaluating the sequence.	1. I can determine if a situation should be represented by an arithmetic or geometric sequence. 2. I can create arithmetic and geometric sequences recursively using function notation.

	3. I can write arithmetic and geometric sequences explicitly using function notation. 4. I can use arithmetic and geometric sequences to make predictions.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 End of Unit Test: One Variable Statistics Algebra 2-1-End-of-Unit-Assessment-teacher-guide 1. I can tell the difference between geometric and arithmetic sequences. TEST Questions: #3, #6 2. I can create arithmetic and geometric sequences recursively using function notation. TEST Questions: #1, #2, #3, #4, #7 3. I can define arithmetic and geometric sequences explicitly using function notation. TEST Questions: #2, #3, #5, #6, #7 4. I can use arithmetic and geometric sequences to make predictions. TEST Questions: #7	Pre- Assessment: Algebra 2-1-Check-Your-Readiness-teacher-guide Unit 1 Check Your Readiness Assessment Ongoing Assessments: Algebra 2 Unit 1 Cool Downs Algebra 2 Unit 1 Quizzes

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Arithmetic and Geometric Sequences	**Estimated # of Lessons: 7**
Learning Target(s): 1. I can determine if a situation should be represented by an arithmetic or geometric sequence. 2. I can create arithmetic and geometric sequences recursively using function notation. 3. I can write arithmetic and geometric sequences explicitly using function notation	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real- world scenarios?
Learning Activities:	

1. Analyzing number sequences and computing common differences or common ratios. 2. Analyzing number sequences and deciding if they are arithmetic, geometric or neither. 3. Creating arithmetic and/or geometric sequences of numbers given certain parameters.
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Second Unit Topic: Formulas for arithmetic and geometric sequences	**Estimated # of Lessons: 4**
Learning Target(s): 3. I can write arithmetic and geometric sequences explicitly using function notation. 4. I can use arithmetic and geometric sequences to make predictions.	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real- world scenarios?
Learning Activities: 1. Creating formulas that model given arithmetic and/or geometric sequences of numbers. 2. Utilizing given formulas to analyze, manipulate and calculate given arithmetic and/or geometric sequences.	
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COURSE NAME: Algebra 2 Sixth Unit - Algebra 2 IM Unit 3: Complex Numbers and Rational Exponents Est. Time: 6 Weeks (19 lessons, meets every other day)	
OVERVIEW *In this unit, students use what they know about exponents and radicals to extend exponent rules to include rational exponents. Students will solve various equations involving squares and square roots, develop the concept of complex numbers by defining a new number whose square is -1, and use complex numbers to find solutions to quadratic equations.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSN-RN.A:** Extend the properties of exponents to rational exponents. **HSA-REI.A:** Understand solving equations as a process of reasoning and explain the reasoning. **HSN.CN.A:** Perform arithmetic operations with complex numbers. **HSN.CN.B:** Represent complex numbers and their operations on the complex plane. **HSA-REI.B:** Solve equations and inequalities in one variable.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #6: Attend to precision. ● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #7: Look for and make use of structure. ● SELF-DIRECTION: Persevere through frustration when challenging situations or temporary failures arise. MP #5: Use appropriate tools strategically.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Use radicals to rewrite expressions that have unit fraction exponents and other kinds of fractions for exponents. • Connect the radical symbols with solutions to quadratic and cubic equations and determine the number of solutions the equation has. • Imaginary and complex numbers are introduced and performing mathematical operations on complex numbers. • Using knowledge of square roots and complex numbers, solve quadratic equations that have complex solutions. Practice completing the square and using the quadratic formula.	● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots? ● What is a complex number and how can it be used to find solutions to quadratic equations?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to know when equations involving rational exponents do not have real number solutions and instead have complex solutions.	1. I can write and interpret exponents that are positive and negative fractions 2. I can solve an equation with a square root, cube root or other radicals 3. I can identify and perform operations on an imaginary or complex number 4. I can find complex solutions to quadratic equations by using the completing the square process or quadratic formula

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 3 Test: Complex Numbers and Rational Exponents Algebra 2 Unit 3 End of Unit Assessment 1. I can write and interpret exponents that are positive and negative fractions TEST Question: #1 2. I can solve an equation with a square root, cube root or other radicals TEST Questions: #3, #6 3. I can identify and perform operations on an imaginary or complex number TEST Questions: #3, #4 4. I can find complex solutions to quadratic equations by using the completing the square process or quadratic formula TEST Questions: #2, #3, #5, #7	Pre- Assessment: Algebra 2-3-Check-Your-Readiness-teacher-guide Unit 3 Check Your Readiness Assessment Ongoing Assessments: Algebra 2 Unit 3 Cool Downs Algebra 2 Unit 3 Quizzes

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponent Properties	**Estimated # of Lessons: 5**
Learning Target(s): 1. I can write and interpret exponents that are positive and negative fractions.	**Essential Question:** ● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?
Learning Activities: 1. Evaluate expressions with integer exponents. 2. Calculate square and cube roots. 3. Write square and cube roots as exponents. 4. Interpret exponents that are fractions. 5. Interpret exponents that are negative fractions.	
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Second Unit Topic: Solving Equations with Square and Cube Roots.	**Estimated # of Lessons: 4**
Learning Target(s): 2. I can solve an equation with a square root, cube root or other radicals.	**Essential Question:** ● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?
Learning Activities:	

1. Understand that the square root symbol means the positive square root. 2. Solve equations by squaring or finding square roots. 3. Solve equations by cubing or finding cube roots. 4. Solve equations with radicals in them.	
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Third Unit Topic: A New Kind of Number	**Estimated # of Lessons: 6**
Learning Target(s): 3. I can identify and perform operations on an imaginary or complex number.	**Essential Question:** • What is a complex number and how can it be used to find solutions to quadratic equations?
Learning Activities: 1. Represent $\sqrt{-1}$ and multiples of it. 2. Use i to solve equations. 3. Add complex numbers and calculate powers of imaginary numbers. 4. Multiply complex numbers. 5. Do arithmetic with complex numbers. 6. Find real and imaginary parts of complex numbers if I know enough about the numbers and their product.	
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Fourth Unit Topic: Solving Quadratics with Complex Numbers	**Estimated # of Lessons: 4**
Learning Target(s): 4. I can find complex solutions to quadratic equations use the completing the square process or quadratic formula.	**Essential Questions:** • How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots? • What is a complex number and how can it be used to find

	solutions to quadratic equations?

Learning Activities:

1. Solve quadratic equations by completing the square or by using the quadratic formula.
2. Find complex solutions to quadratic equations by completing the square.
3. Find complex solutions to quadratic equations by using the quadratic formula.
4. Find complex solutions to quadratic equations.

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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 First Unit-Algebra 1 IM 6: Quadratic Functions
Est. Time: 6 Weeks (14 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will look at and compare different number patterns. Specifically, these will include linear, exponential, and quadratic patterns. Students will interpret, represent, and analyze quadratic functions algebraically, graphically, and in tables. Students will see how expressions in standard, factored, and vertex form reveal important behavior and features of quadratic relationships. Students will study a variety of real-world problems that can be analyzed with quadratic functions.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSA-SSE.A: Interpret the structure of expressions.
HSA-SSE.B: Write expressions in equivalent forms to solve problems.
HSF-BF.A: Build a function that models a relationship between two quantities.
HSF-BF.B: Build new functions from existing functions.
HSF-IF.A: Understand the concept of a function and use function notation.
HSF-IF.B: Interpret functions that arise in applications in terms of the context.
HSF-IF.C: Analyze functions using different representations.
HSF-LE.A: Construct and compare linear, quadratic, and exponential models and solve problems.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #3: Construct viable arguments
MP #5: Use appropriate tools strategically.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #8: Look for and express regularity in repeated reasoning.
● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.
MP #2: Reason abstractly and quantitatively.
MP #4: Model with mathematics.
● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Functions often have different forms that describe the same situation, but specific forms are more efficient at answering certain questions.</td><td>● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?</td></tr>
</table>

• Many real-world situations can be modeled or approximated using quadratic functions.	• How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to determine that quadratic relationships involving x^2 change differently than linear relationships. How to decipher the difference between factored form, standard form, and vertex form, and when they are useful.	1. (FOUNDATIONAL) I can identify, compare, and contrast quadratic, linear, and exponential patterns. 2. I can write and interpret a quadratic expression that represents a situation. 3. I can rewrite factored form as standard form. 4. I can identify key graph features (intercepts, vertex, max/min) when given quadratics in different forms. 5. I can explain how changing the a, b, and c values in a quadratic equation $y = ax^2 + bx + c$ affects the graph. 6. I can explain how changing the a, h, and k values in a quadratic equation $y = a(x - h)^2 + k$ affects the graph.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 Test: Quadratic Functions Unit 6 Test.docx 1. (FOUNDATIONAL) I can identify, compare, and contrast quadratic, linear, and exponential patterns. 2. I can write and interpret a quadratic expression that represents a situation. TEST Question: #6 3. I can rewrite factored form as standard form. TEST Questions: #3, #4, #6 4. I can identify key graph features (intercepts, vertex, max/min) when given quadratics in different forms. TEST Questions: #1, #2, #3, #5, #6 5. I can explain how changing the a, b, and c values in a quadratic equation $y = ax^2 + bx + c$ affects the graph. TEST Questions: #4, #5 6. I can explain how changing the a, h, and k values in a quadratic equation $y = a(x - h)^2 + k$ affects the graph. TEST Questions: #2, #4	Pre- Assessment: Algebra 1 Unit 6 Check-Your-Readiness Ongoing Assessments: Algebra 1 Unit 6 Cool Downs Algebra 1 Unit 6 Curated Problem Sets
Performance Task: Students will draw a trophy using graphing technology by applying the skills and knowledge of the unit regarding features of quadratic functions and considering the Essential Question: How does the equation of a function provide us information about the relationship between its inputs and outputs? ● Transfer Skills: Critical Thinking, Self Direction ● Understandings: #1 ● Learning Targets: #4, 5, 6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION

First Unit Topic: Quadratic Expressions and Functions	**Estimated # of Lessons: 7**
Learning Target(s): 1. (FOUNDATIONAL) I can identify, compare, and contrast quadratic, linear, and exponential patterns. 2. I can write and interpret a quadratic expression that represents a situation. 3. I can rewrite factored form as standard form.	**Essential Questions:** • How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? • How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
Learning Activities: 1. Use tables of values in context to identify and explore a new kind of relationship (quadratic) between inputs and outputs. 2. Analyze objects in trajectory problems to explore an application of quadratic functions and the connections between the functions and parameters in the situation. 3. Use area diagrams to explore distributing and converting factored form into standard form. 4. Begin making connections between standard form, factored form, and graphs of quadratic functions through a matching activity.	
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Second Unit Topic: Features of Graphs of Quadratic Functions	**Estimated # of Lessons: 7**
Learning Target(s): 4. I can identify key graph features (intercepts, vertex, max/min) when given quadratics in different forms.	**Essential Questions:** • How does the equation of a function provide us information about the relationship between its inputs and outputs? How

<table>
<tr><td>

5. I can explain how changing the $a,\ b$, and c values in a quadratic equation $y = ax^2 + bx + c$ affects the graph.
6. I can explain how changing the $a,\ h$, and k values in a quadratic equation $y = a(x - h)^2 + k$ affects the graph.

</td><td>

are new functions connected to functions I am already familiar with?

- How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?

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Learning Activities:

1. Use tables of values to locate x-intercepts and the vertex. Then formalize the connections between factored form, the x-intercepts, and the vertex.
2. Use graphing technology (Desmos) to explore how the different coefficients in standard form affect the graph of the function. Solidify these connections in a matching activity.
3. Given a graph, practice writing equations that would have the same key graph features.
4. Use graphing technology (Desmos) to explore how the parameters in vertex form affect the graph of the function. Solidify these connections in a matching activity.
5. Develop an equation that will result in a trajectory that allows a peanut to jump over a wall. Use graphing technology to help.

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</table>

COURSE NAME: Algebra 2 **Second Unit- Algebra 1 IM 7: Quadratic Equations** **Est. Time: 7 Weeks (24 Lessons, meets every other day)**	
OVERVIEW *In this unit, students will write, interpret, and solve quadratic equations. Students will use quadratic equations to model real-world situations and solve problems. Students will learn a variety of ways to solve quadratic equations, including using basic algebraic reasoning, graphing, factoring, completing the square, and the quadratic formula. They will see that certain strategies are more effective in different situations. At the end of the unit, students will bring together the new material of this unit and the content from Unit 6 to fully and precisely analyze situations involving quadratic functions.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSA-SSE.A:** Interpret the structure of expressions. **HSA-SSE.B:** Write expressions in equivalent forms to solve problems. **HSA-REI.B:** Solve equations and inequalities in one variable. **HSN-RN.B:** Use properties of rational and irrational numbers. **HSA-CED.A:** Create equations that describe numbers or relationships.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments and critique reasoning of others MP #5: Use appropriate tools strategically. ● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #8: Look for and express regularity in repeated reasoning. ● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #2: Reason abstractly and quantitatively. MP #4: Model with mathematics. ● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Functions often have different forms that describe the same situation, but specific forms are more efficient at answering	● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions

certain questions. ● Many real-world situations can be modeled or approximated using quadratic functions.	connected to functions I am already familiar with? ● How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to solve quadratic equations using multiple strategies. In different situations, different strategies may be more efficient. How to determine if quadratic equations have 0, 1, or 2 real-number solutions and whether these solutions are rational or irrational numbers.	1. I can solve quadratic equations using algebraic reasoning. 2. I can use a graph to identify the solutions of a quadratic equation. 3. I can rewrite a quadratic expression in factored form and use factored form to help solve a quadratic equation. 4. I can complete the square and use this strategy to solve quadratic equations. 5. I can use the quadratic formula to solve quadratic equations. 6. I can write quadratic equations to model situations and solve problems. 7. I can determine if the solutions to a quadratic equation are rational or irrational.

<table>
<tr><th colspan="2">STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 7 Test: Quadratic Equations

Unit 7 Mid-Unit Test: Quadratic Equations
1. I can solve quadratic equations using algebraic reasoning.
TEST Questions: #1, #5, #6

2. I can use a graph to identify the solutions of a quadratic equation.
TEST Question: #2

3. I can rewrite a quadratic expression in factored form and use factored form to help solve a quadratic equation.
TEST Questions: #3, #4, #5, #6

6. I can write quadratic equations to model situations and solve problems.
TEST Questions: #7

Unit 7 End-of-Unit Test: Quadratic Equations
4. I can complete the square and use this strategy to solve quadratic equations.
TEST Questions: #1, #5

5. I can use the quadratic formula to solve quadratic equations.
TEST Questions: #2, #9

6. I can write quadratic equations to model situations and solve problems.
TEST Question: #3

7. I can determine if the solutions to a quadratic equation are rational or irrational.
TEST Question: #4</td><td>Pre- Assessment:
Algebra 1 Unit 7
Check-Your-Readiness

Ongoing Assessments:
Algebra 1 Unit 7 Cool Downs

Algebra 1 Unit 7 Curated Problem Sets</td></tr>
</table>

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Solving Quadratic Equations	**Estimated # of Lessons: 9**

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Learning Target(s):

1. I can solve quadratic equations using algebraic reasoning.

2. I can use a graph to identify the solutions of a quadratic equation.

3. I can rewrite a quadratic expression in factored form and use factored form to help solve a quadratic equation.

6. I can write quadratic equations to model situations and solve problems.

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Essential Questions:

- How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?

- How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?

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Learning Activities:

1. Attempt to solve several quadratic equations in context and notice that some can be solved using algebra skills they already have, while others cannot.
2. Notice while solving sample quadratic equations that many have 2 solutions, while others only have 1 or 0 real solutions.
3. Observe that factored form can be useful for solving quadratic equations and will gradually develop a strategy for factoring.
4. Identify factoring patterns that allow for shortcuts when factoring certain types of quadratic expressions.

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<td colspan="2">https://im.kendallhunt.com</td>
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</table>

Second Unit Topic: Features of Graphs of Quadratic Functions	**Estimated # of Lessons: 7**
Learning Target(s):	**Essential Questions:**

4. I can complete the square and use this strategy to solve quadratic equations. 5. I can use the quadratic formula to solve quadratic equations. 6. I can write quadratic equations to model situations and solve problems. 7. I can determine if the solutions to a quadratic equation are rational or irrational.	• How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? • How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?

Learning Activities:

1. Recall what a perfect square is, then observe that quadratic equations can often be rewritten as the square of a linear factor.
2. Introduce the quadratic formula as a potential strategy for solving quadratic equations, then practice using it.
3. Derive the quadratic formula by completing the square for a general quadratic equation.
4. Convert between exact notations and decimal approximations for irrational solutions. Determine what makes a solution irrational.
5. Model quadratic scenarios with functions. Use these functions to find the zeros, maximum/minimum value, and other important points related to the situation.

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COURSE NAME: Algebra 2 Third Unit- Algebra 2 IM 1: Sequences and Functions **Est. Time: 5 Weeks (11 Lessons, meets every other day)**	
OVERVIEW *In this unit, students will continue to examine functions from Algebra I by extending into geometric and arithmetic sequences which reinforces the concepts of exponential and linear functions.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF-IF.A:** Understand the concept of a function and use function notation. **HSF-IF.C:** Analyze functions using different representations.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #8: Look for and express regularity in repeated reasoning.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Modeling of real-world scenarios, with the use of sequences, allows for predictions to be made in the past or in the future. ● Different situations are modeled better by arithmetic or geometric sequences.	● What is a function and how are functions defined to model and predict behavior of real- world scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to construct the model of a sequence so that predictions can be made by evaluating the sequence.	1. I can determine if a situation should be represented by an arithmetic or geometric sequence. 2. I can create arithmetic and geometric sequences recursively using function notation.

	3. I can write arithmetic and geometric sequences explicitly using function notation. 4. I can use arithmetic and geometric sequences to make predictions.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 1 End of Unit Test: One Variable Statistics
Algebra 2-1-End-of-Unit-Assessment-teacher-guide
1. I can tell the difference between geometric and arithmetic sequences.
TEST Questions: #3, #6

2. I can create arithmetic and geometric sequences recursively using function notation.
TEST Questions: #1, #2, #3, #4, #7

3. I can define arithmetic and geometric sequences explicitly using function notation.
TEST Questions: #2, #3, #5, #6, #7

4. I can use arithmetic and geometric sequences to make predictions.
TEST Questions: #7</td><td>Pre- Assessment: Algebra 2-1-Check-Your-Readiness-teacher-guide

Ongoing Assessments: Algebra 2 Unit 1 Cool Downs

Algebra 2 Unit 1 Curated Problem Sets</td></tr>
<tr><td>Performance Task: Students will be given several situations where it makes sense to define them using a geometric or arithmetic sequence and then find the sum of this sequence. The task has a hands-on nature, to help students make sense of why we need to add up terms in a sequence in some situations. As part of this process, students will address the Essential Question: How are arithmetic and geometric sequences defined to model and predict behavior of real-world scenarios?
● Transfer Skills: Critical Thinking
● Understandings: #1
● Learning Targets: #3, #4</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Arithmetic and Geometric Sequences</td><td>Estimated # of Lessons: 7</td></tr>
<tr><td>Learning Target(s):</td><td>Essential Questions:
● What is a function and how are functions defined</td></tr>
</table>

1. I can determine if a situation should be represented by an arithmetic or geometric sequence. 2. I can create arithmetic and geometric sequences recursively using function notation. 3. I can write arithmetic and geometric sequences explicitly using function notation	to model and predict behavior of real- world scenarios?
Learning Activities: 1. Analyzing number sequences and computing common differences or common ratios. 2. Analyzing number sequences and deciding if they are arithmetic, geometric or neither. 3. Creating arithmetic and/or geometric sequences of numbers given certain parameters.	
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Second Unit Topic: Formulas for arithmetic and geometric sequences	**Estimated # of Lessons: 4**
Learning Target(s): 3. I can write arithmetic and geometric sequences explicitly using function notation. 4. I can use arithmetic and geometric sequences to make predictions.	**Essential Questions:** • What is a function and how are functions defined to model and predict behavior of real- world scenarios?
Learning Activities: 1. Creating formulas that model given arithmetic and/or geometric sequences of numbers. 2. Utilizing given formulas to analyze, manipulate and calculate given arithmetic and/or geometric sequences.	
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COURSE NAME: Algebra 2 Fourth Unit-Algebra 2 IM 2: Polynomials and Rational Functions Est. Time: 7 Weeks (26 lessons, meets every other day)	
OVERVIEW *In this unit, students will expand their understanding of functions to include the family of functions known as polynomials. Previously, students have worked with linear and quadratic functions, which are part of this family. They will analyze the connections between the equations and graphs of polynomials and look at contexts that can be modeled with polynomials. Later in this unit, students will investigate rational functions, which are made by dividing two polynomials.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSA.APR.A:** Perform arithmetic operations on polynomials. **HSA.APR.B:** Understand the relationship between zeros and factors of polynomials. **HSA.APR.C:** Use polynomial identities to solve problems. **HSA.APR.D:** Rewrite rational expressions. **HSA.CED.A:** Create equations that describe numbers or relationships. **HSA.REI.A:** Understand solving equations as a process of reasoning and explain the reasoning. **HSA.REI.C:** Solve systems of equations. **HSA.REI.D:** Represent and solve equations and inequalities graphically. **HSA.SSE.B:** Write expressions in equivalent forms to solve problems. **HSF.IF.B:** Interpret functions that arise in applications in terms of the context. **HSF.IF.C:** Analyze functions using different representations.	• CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Polynomials and rational functions can be used to model a wide variety of real-world scenarios.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • What are some of the strategies we can use to find an unknown quantity and what

	are the advantages and disadvantages of these different strategies?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to recognize polynomial functions as a general family of functions that include quadratics and understand rational functions as a result of the division of polynomial functions.	1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations. 7. I can solve rational equations.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Mid-Test: Polynomials and Rational Functions Algebra 2 Unit 2 Mid-Unit Test 1. I can write equivalent expressions for polynomial and rational expressions. Test Question: #1, #5	Pre- Assessment: Algebra 2 Unit 2 Check-your-Readiness Ongoing Assessments:

2. I can determine the zeros and factors of a polynomial function from the equation or graph. Test Question: #2, #5, #6 3. I can determine the points of intersection of polynomial functions. Test Question: #3 4. I can sketch a graph of a polynomial function when given the equation of the function. Test Question: #7 5. I can analyze key graph features of polynomials and rational functions. Test Question: #4, #7 6. I can write and analyze polynomial and rational expressions to represent real-world situations. Test Question: #4 Unit 2 End of Unit Test: Polynomials and Rational Functions Algebra 2 Unit 2 End-of-Unit Test 1. I can write equivalent expressions for polynomial and rational expressions. Test Question: #1, #5 2. I can determine the zeros of a polynomial function from the equation or graph. Test Question: #3 5. I can analyze key graph features of polynomials and rational functions. Test Question: #3 6. I can write and analyze polynomial and rational expressions to represent real-world situations. Test Question: #2, #6, #7 7. I can solve rational equations. Test Question: #4	Algebra 2 Unit 2 Cool Downs Algebra 2 Unit 2 Curated Problem Sets
Performance Task: The purpose of this lesson is for students to practice solving rational equations strategically and understand how certain steps in the solving process can lead to equations that are not equivalent to the initial equation. ● Transfer Skills: Critical Thinking ● Understandings: #1 ● Learning Targets: #7	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Polynomials	**Estimated # of Lessons: 13**

Learning Target(s):	Essential Questions:
1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations.	● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?

Learning Activities:
1. Consider the scenario of trying to maximize the volume of a box as an introduction to polynomial expressions. 2. Use graphing technology to observe a pattern between the factored form of a polynomial and its zeros. 3. Use graphing technology to begin analyzing end behavior and multiplicity of polynomials. 4. Use application problems as an introduction to dividing polynomial functions.
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Second Unit Topic: Rational Functions	Estimated # of Lessons: 13
Learning Target(s): 1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and

5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations. 7. I can solve rational equations.	disadvantages of these different strategies?

Learning Activities:

1. Use additional application problems to begin modeling using division of polynomial functions, then transition this understanding into rational functions.
2. Use graphing technology to help analyze key graph features of rational functions.
3. Look at completed sample problems to being exploring useful strategies for solving rational equations.

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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Fifth Unit- Algebra 2 IM 3: Complex Numbers and Rational Exponents
Est. Time: 4 Weeks (19 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students use what they know about exponents and radicals to extend exponent rules to include rational exponents. Students will solve various equations involving squares and square roots, develop the concept of complex numbers by defining a new number whose square is -1, and use complex numbers to find solutions to quadratic equations.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSN-RN.A: Extend the properties of exponents to rational exponents.
HSA-REI.A: Understand solving equations as a process of reasoning and explain the reasoning.
HSN.CN.A: Perform arithmetic operations with complex numbers.
HSN.CN.B: Represent complex numbers and their operations on the complex plane.
HSA-REI.B: Solve equations and inequalities in one variable.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
MP #6: Attend to precision.
● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #7: Look for and make use of structure.
● SELF-DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #5: Use appropriate tools strategically.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>• Use radicals to rewrite expressions that have unit fraction exponents and other kinds of fractions for exponents.
• Connect the radical symbols with solutions to quadratic and cubic equations and determine the number of solutions the equation has.
• Imaginary and complex numbers are introduced and performing mathematical operations on complex numbers.
• Using knowledge of square roots and complex numbers, solve quadratic equations that have complex solutions. Practice completing the square and using the quadratic formula.</td><td>● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?
● What is a complex number and how can it be used to find solutions to quadratic equations?</td></tr>
</table>

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to know when equations involving rational exponents do not have real number solutions and instead have complex solutions.	1. I can write and interpret exponents that are positive and negative fractions 2. I can solve an equation with a square root, cube root or other radicals 3. I can identify and perform operations on an imaginary or complex number 4. I can find complex solutions to quadratic equations by using the completing the square process or quadratic formula

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 3 Test: Complex Numbers and Rational Exponents Algebra 2 Unit 3 End of Unit Assessment 1. I can write and interpret exponents that are positive and negative fractions TEST Question: #1 2. I can solve an equation with a square root, cube root or other radicals TEST Questions: #3, #6 3. I can identify and perform operations on an imaginary or complex number TEST Questions: #3, #4 4. I can find complex solutions to quadratic equations by using the completing the square process or quadratic formula TEST Questions: #2, #3, #5, #7	Pre- Assessment: Check your readiness Ongoing Assessments: Algebra 2 Unit 3 Cool Downs Algebra 2 Unit 3 Curated Problem Sets

Performance Task: Students begin by predicting how many real solutions a quadratic equation will have. Next, they create, and solve, their own quadratic equations that have either real or non-real solutions. They will need to see and make use of the structure of quadratic equations and build on the thinking where they use the quadratic formula to find non-real solutions to quadratic equations. Used to answer the essential question: What is a complex number and how can it be used to find solutions to quadratic equations? ● Transfer Skills: Communication, Critical Thinking and Self-Direction ● Understanding: #4 ● Learning Target: #4	Algebra 2 Unit 3 Real and Non-Real Solutions

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponent Properties	**Estimated # of Lessons: 5**
Learning Target(s): 1. I can write and interpret exponents that are positive and negative fractions.	**Essential Question:** ● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?
Learning Activities: 1. Evaluate expressions with integer exponents. 2. Calculate square and cube roots. 3. Write square and cube roots as exponents. 4. Interpret exponents that are fractions. 5. Interpret exponents that are negative fractions.	
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<table>
<tr><td>Second Unit Topic: Solving Equations with Square and Cube Roots.</td><td>Estimated # of Lessons: 4</td></tr>
<tr><td>Learning Target(s):

2. I can solve an equation with a square root, cube root or other radicals.</td><td>Essential Question:

● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Understand that the square root symbol means the positive square root.
2. Solve equations by squaring or finding square roots.
3. Solve equations by cubing or finding cube roots.
4. Solve equations with radicals in them.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
<tr><td>Third Unit Topic: A New Kind of Number</td><td>Estimated # of Lessons: 6</td></tr>
<tr><td>Learning Target(s):

3. I can identify and perform operations on an imaginary or complex number.</td><td>Essential Question:

● What is a complex number and how can it be used to find solutions to quadratic equations?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Represent $\sqrt{-1}$ and multiples of it.
2. Use i to solve equations.
3. Add complex numbers and calculate powers of imaginary numbers.
4. Multiply complex numbers.
5. Do arithmetic with complex numbers.
6. Find real and imaginary parts of complex numbers if I know enough about the numbers and their product.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

Fourth Unit Topic: Solving Quadratics with Complex Numbers	Estimated # of Lessons: 4
Learning Target(s): 4. I can find complex solutions to quadratic equations use the completing the square process or quadratic formula.	**Essential Questions:** ● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots? ● What is a complex number and how can it be used to find solutions to quadratic equations?
Learning Activities: 1. Solve quadratic equations by completing the square or by using the quadratic formula. 2. Find complex solutions to quadratic equations by completing the square. 3. Find complex solutions to quadratic equations by using the quadratic formula. 4. Find complex solutions to quadratic equations.	
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Sixth Unit-Algebra 2 IM 4: Exponential Functions and Equations
Est. Time: 6 Weeks (14 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will work with exponential relationships in the context of real-world problems and represent them with equations, tables, and graphs.</td></tr>
<tr><td colspan="2" align="center">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td align="center">ESTABLISHED GOALS</td><td align="center">TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSF-LE.A: Construct and compare linear, quadratic, and exponential models and solve problems.
HSF-LE.B: Interpret expressions for functions in terms of the situation they model.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #2: Reason abstractly and quantitatively.</td></tr>
<tr><td align="center">UNDERSTANDINGS</td><td align="center">ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Exponential functions can be used to model situations in which a quantity changes by a constant factor and these functions can be represented in a variety of ways (table, graph, equations).

● Technology can be a good way to find an approximate solution to an exponential equation, but logarithms are necessary for finding exact solutions to some exponential problems.

● Logarithms can be used to model situations directly, in addition to as a tool for solving exponential equations.</td><td>● What is an exponential function and how are exponential functions utilized to model and predict behavior of real- world scenarios?

● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?</td></tr>
<tr><td align="center">KNOWLEDGE</td><td align="center">SKILLS (framed as Learning Targets)</td></tr>
</table>

How to recognize exponential situations in real-world contexts and use equations to model them. How to reason that exponential and logarithmic representations are connected and can be useful in different situations.	1. I can determine the growth/decay factor and rate for an exponential situation. 2. I can use exponential equations to make predictions in real-world contexts. 3. I can interpret exponential equations in context. 4. I can write exponential equations when given information in a word problem, table, or graph. 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs. 6. I can solve exponential equations using logarithms. 7. I can convert between exponential and logarithmic form. 8. I can interpret logarithmic functions in context. 9. I can evaluate logarithms.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 Mid-Unit Assessment: Exponential Functions Unit 4 Mid-Unit Assessment 1. I can determine the growth/decay factor and rate for an exponential situation. TEST Question: #1, #3, #6, #7 2. I can use exponential equations to make predictions in real-world contexts. TEST Question: #4, #5, #6 3. I can interpret exponential equations in context. TEST Question: #2, #6 4. I can write exponential equations when given information in a word problem, table, or graph. TEST Question: #3, #4, #5, #7 Unit 4 End of Unit Assessment: Exponential and Logarithmic Functions Unit 4 End-of-Unit Assessment 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs. TEST Question: #1, #5, #7 6. I can solve exponential equations using logarithms. TEST Question: #2, #3, #5, #6, #7 7. I can convert between exponential and logarithmic form. TEST Question: #2 8. I can interpret logarithmic functions in context. TEST Question: #4 9. I can evaluate logarithms. TEST Question: #1, #2, #4	Pre- Assessment: Algebra 2 Unit 4 Check Your Readiness Ongoing Assessments: Algebra 2 Unit 4 Cooldowns Algebra 2 Unit 4 Curated Problem Sets
Performance Task: Students will be introduced to two new real-world situations, pH and the Richter scale, in which an exponential/logarithmic	

relationship is evident, but the exact model is not immediately obvious. Students will then work to develop functions that can model these situations, addressing the Essential Question: What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? ● Transfer Skills: Synthesize information to solve problems and defend claims. ● Understandings: #3 ● Learning Targets: #7, #8, #9	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponential Functions/Growth and Decay	**Estimated # of Lessons: 9**
Learning Target(s): 1. I can determine the growth/decay factor and rate for an exponential situation. 2. I can use exponential equations to make predictions in real-world contexts. 3. I can interpret exponential equations in context. 4. I can write exponential equations when given information in a word problem, table, or graph. 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs.	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real- world scenarios? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Analyze situations involving exponential growth or decay by identifying the growth/decay factor and noticing that exponents can be used to simplify computation. 2. Practice representing exponential situations using functions. Use these functions to make predictions about the situation. 3. Analyze exponential situations involving rational inputs (including negative values). Explain what these inputs and corresponding outputs represent in context. 4. Find missing exponent values using graphs and guess-and-check.	
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Second Unit Topic: Logarithms	Estimated # of Lessons: 5
Learning Target(s): 6. I can solve exponential equations using logarithms. 7. I can convert between exponential and logarithmic form. 8. I can interpret logarithmic functions in context. 9. I can evaluate logarithms.	**Essential Questions:** ● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Use a logarithm table to begin considering what a logarithm is. 2. Practice converting between logarithmic and exponential form. 3. Explore the scenario where a value grows by a tiny amount many times and use this to introduce the number e. 4. Investigate model sample problems to introduce solving exponential equations using logarithms. 5. Model situations using logarithms and consider how to connect these models to exponential situations.	
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COURSE NAME: Algebra 2 **Seventh Unit-Algebra 2 IM 7: Statistical Inferences** **Est. Time: 5 Weeks (16 lessons, meets every other day)**	
OVERVIEW *In this unit students will build on their middle school skills of collecting samples from a population and using information about those samples to estimate characteristics for the population. Here students will explore the normal distribution and apply understanding of the distribution to provide estimates with a margin of error. This unit will also look at experimental studies, observational studies, and surveys.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSS-IC.A:** Understand and evaluate random processes underlying statistical experiments. **HSS-IC.B:** Make inferences and justify conclusions from sample surveys, experiments, and observational studies. **HSS-ID.A:** Summarize, represent, and interpret data on a single count or measurement variable.	● CRITICAL THINKING: Identify a problem, ask key questions and make predictions. MP #1: Make sense of problems and persevere in solving them. MP #2 Reason abstractly and quantitatively. ● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3 Construct viable arguments and critique the reasoning of others. ● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #3 Construct viable arguments and critique the reasoning of others.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Use data collected from a sample of a population in question. A process of randomization is used to reduce the amount of bias in the sample. Create statistical measures from this population and use a margin of error to estimate how much the statistics will vary. ● Make inferences using the statistics and margin of error found from the sample. Use the inferences to answer questions about the normal distribution of the population.	● How can statistics be collected, displayed, and analyzed in an unbiased fashion? ● How can an event be both random and predictable?

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to use different statistical questions based on the type of study. Emphasize the importance of random selection for gathering a sample for surveys and observational studies and the importance of random assignment in experimental studies. How to analyze data by examining the shapes of distributions and focusing on the normal distribution as a common and standardized shape. Data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. How to analyze the results from experimental studies to estimate population means and proportions with a margin of error based on data from surveys. How to determine whether experimental data is likely due to the chance arrangement of groups or the experimental treatment.	1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. 2. I can understand and be able to explain the importance of random selection for gathering a sample for surveys and observational studies. 3. I can understand the importance of random assignment in experimental studies. 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. 6. I can analyze the results from experimental studies. 7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance

	arrangement of the groups or the experimental treatment.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 Mid-Unit Assessment: Statistical Inferences Algebra 2 Unit 7 Mid-Unit Assessment 1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. Test Question #5, #7 2. I can understand and be able to describe the importance of random selection for gathering a sample for surveys and observational studies. Test Question #6 3. I can understand and be able to describe the importance of random assignment in experimental studies. Test Question #1, #6, #7 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. Test Questions: #2, #3, #7 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. Test Questions: #3, #7 6. I can analyze the results from experimental studies. Test Questions: #4, #7	Pre- Assessment: Algebra 2 Unit 7 Check your Readiness Ongoing Assessment: Algebra 1 Unit 7 Cool Downs Algebra 2 Unit 7 Curated Problem Sets

7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. Test Question: not yet addressed. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. Test Question #4 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Test Question #5 Unit 7 End of Unit Assessment: Statistical Inferences Algebra 2 Unit 7 End of Unit Assessment 1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. Test Question #7 2. I can understand and be able to describe the importance of random selection for gathering a sample for surveys and observational studies. Test Question #5 3. I can understand and be able to describe the importance of random assignment in experimental studies. Test Question #3, #4 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. Test Question #7 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional	

information such as the proportion of data expected within certain intervals. Test Question #7 6. I can analyze the results from experimental studies. Test Question #3, 5 7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. Test Question #1, #2, #6 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. Test Question #2, #4 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Test Question #5, #7	
Performance Task: Students collect data from an experiment involving their heart rates and analyze the data using randomization distributions. An understanding of the normal distribution is used to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Used to answer the essential question: How can an event be both random and predictable? • Transfer Skills: Research and Understanding • Understandings: #2 • Learning Target: #9	Algebra 2 Unit 7 Lesson 16 Heart Rates

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Study Types	**Estimated # of Lessons: 3**
Learning Target(s):	**Essential Question:**

1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. 2. I can understand and be able to explain the importance of random selection for gathering a sample for surveys and observational studies. 3. I can understand and be able to explain the importance of random assignments in experimental studies.	• How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Decide if a study is good or bad based on evidence. 2. Recognize the difference between a survey, observational study, or experimental study. 3. Understand why randomization is important in the design of a study. 4. Describe the different purposes for each type of study design (survey, observational study, or experimental study). 5. Recognize the difference between a survey, observational study, or experimental study. 6. Understand that the choice of the design for a study will impact what questions can be answered. 7. Recognize that the way a sample is chosen matters, and that random samples have less bias.	
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Second Unit Topic: Distributions	**Estimated # of Lessons: 4**
Learning Target(s): 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals.	**Essential Question:** • How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities: 1. Describe a distribution using the characteristics of its shape, center, and spread. 2. Use the standard deviation to describe the variability in a distribution. 3. Calculate a relative frequency and create a relative frequency histogram. 4. Know that a normal curve is defined using the mean and standard deviation. 5. Calculate a proportion of a set of data that matches a shaded area in a histogram. 6. Recognize the patterns of proportions that occur in distributions that are approximately normal in shape. 7. Use the mean and standard deviation of a normally distributed data set to estimate intervals when given a proportion. 8. Use the mean and standard deviation of a normally distributed data set to estimate proportions.
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Third Unit Topic: Not all Samples are the Same	**Estimated # of Lessons: 5**
Learning Target(s): 6. I can analyze the results from experimental studies. 7. I can understand what margin of error means and be able to estimate using the mean and standard deviation. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section.	**Essential Question:** • How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Justify a mathematical claim using evidence. 2. Use mathematical evidence to find the difference between when outcomes are unfair or due to random chance. 3. Understand why it is important to be skeptical of data that seems unfair. 4. Estimate the margin of error using the mean and standard deviation. 5. Understand that sample means, and proportions can be representative of the overall population. 6. Understand that sample means and proportions vary.	

7. Estimate the margin of error using standard deviation.
8. Understand that a larger margin of error means more variability, and I should be less confident in my estimate of the population mean.
9. Understand that a smaller margin of error means more variability, and I can be more confident in my estimate of the population mean.
10. Understand that different samples from the same population can still have different statistics.
11. Describe why a larger sample size usually leads to a smaller margin of error.
12. Understand that sample size influences the size of the margin of error for a data set.
13. Calculate the mean and standard deviation of sample means and use the information to estimate the margin of error.
14. Understand that sample means that are normally distributed follow the same pattern as sample proportions.

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Fourth Unit Topic: Analyzing Experimental Data	**Estimated # of Lessons: 4**
Learning Target(s): 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment.	**Essential Questions:** ● How can an event be both random and predictable?

Learning Activities:

1. Find the difference between two treatment means and use a randomization distribution to determine whether the result occurred by random chance.
2. Understand why randomization is important in the design of a study.
3. Calculate the difference in means between two groups.
4. Justify whether there is evidence for a statistical claim by using proportions in the normal distribution.
5. Understand that the difference in means can be modeled by a distribution that is approximately normal in shape.
6. Use a randomization distribution to determine whether a treatment was the cause of the results of an experiment, or if the results are due to the random assignment of the groups.
7. Understand why it is important to question the results of an experiment.

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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 First Unit: Algebra 2 IM1: Sequences and Functions
Est. Time: 5 Weeks (11 Lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will continue to examine functions from Algebra I by extending into geometric and arithmetic sequences which reinforces the concepts of exponential and linear functions.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSF-IF.A: Understand the concept of a function and use function notation.
HSF-IF.C: Analyze functions using different representations.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
MP #8: Look for and express regularity in repeated reasoning.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Modeling of real-world scenarios, with the use of sequences, allows for predictions to be made in the past or in the future.
● Different situations are modeled better by arithmetic or geometric sequences.</td><td>● What is a function and how are functions defined to model and predict behavior of real- world scenarios?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>How to construct the model of a sequence so that predictions can be made by evaluating the sequence.</td><td>1. I can determine if a situation should be represented by an arithmetic or geometric sequence.
2. I can create arithmetic and geometric sequences recursively using function notation.</td></tr>
</table>

	3. I can write arithmetic and geometric sequences explicitly using function notation. 4. I can use arithmetic and geometric sequences to make predictions.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 1 End of Unit Test: One Variable Statistics
Algebra 2-1-End-of-Unit-Assessment-teacher-guide
1. I can tell the difference between geometric and arithmetic sequences.
TEST Questions: #3, #6

2. I can create arithmetic and geometric sequences recursively using function notation.
TEST Questions: #1, #2, #3, #4, #7

3. I can define arithmetic and geometric sequences explicitly using function notation.
TEST Questions: #2, #3, #5, #6, #7

4. I can use arithmetic and geometric sequences to make predictions.
TEST Questions: #7</td><td>Pre- Assessment: Algebra 2-1-Check-Your-Readiness-teacher-guide

Ongoing Assessments: Algebra 2 Unit 1 Cool Downs

Algebra 2 Unit 1 Cool Down

Algebra 2 Unit 1 Curated Problem sets</td></tr>
<tr><td>Performance Task: Students will be given several situations where it makes sense to define them using a geometric or arithmetic sequence and then find the sum of this sequence. The task has a hands-on nature, to help students make sense of why we need to add up terms in a sequence in some situations. As part of this process, students will address the Essential Question: How are arithmetic and geometric sequences defined to model and predict behavior of real-world scenarios?
● Transfer Skills: Critical Thinking
● Understandings: #1
● Learning Targets: #3, #4</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Arithmetic and Geometric Sequences</td><td>Estimated # of Lessons: 7</td></tr>
<tr><td>Learning Target(s):</td><td>Essential Questions:
● What is a function and how are functions defined</td></tr>
</table>

1. I can determine if a situation should be represented by an arithmetic or geometric sequence. 2. I can create arithmetic and geometric sequences recursively using function notation. 3. I can write arithmetic and geometric sequences explicitly using function notation	to model and predict behavior of real- world scenarios?
Learning Activities: 1. Analyzing number sequences and computing common differences or common ratios. 2. Analyzing number sequences and deciding if they are arithmetic, geometric or neither. 3. Creating arithmetic and/or geometric sequences of numbers given certain parameters.	
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Second Unit Topic: Formulas for arithmetic and geometric sequences	**Estimated # of Lessons: 4**
Learning Target(s): 3. I can write arithmetic and geometric sequences explicitly using function notation. 4. I can use arithmetic and geometric sequences to make predictions.	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real- world scenarios?
Learning Activities: 1. Creating formulas that model given arithmetic and/or geometric sequences of numbers. 2. Utilizing given formulas to analyze, manipulate and calculate given arithmetic and/or geometric sequences.	
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COURSE NAME: Algebra 2 Second Unit: Algebra 2 IM2 Polynomials and Rational Functions Est. Time: 7 Weeks (26 lessons, meets every other day)	
OVERVIEW *In this unit, students will expand their understanding of functions to include the family of functions known as polynomials. Previously, students have worked with linear and quadratic functions, which are part of this family. They will analyze the connections between the equations and graphs of polynomials and look at contexts that can be modeled with polynomials. Later in this unit, students will investigate rational functions, which are made by dividing two polynomials.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSA.APR.A:** Perform arithmetic operations on polynomials. **HSA.APR.B:** Understand the relationship between zeros and factors of polynomials. **HSA.APR.C:** Use polynomial identities to solve problems. **HSA.APR.D:** Rewrite rational expressions. **HSA.CED.A:** Create equations that describe numbers or relationships. **HSA.REI.A:** Understand solving equations as a process of reasoning and explain the reasoning. **HSA.REI.C:** Solve systems of equations. **HSA.REI.D:** Represent and solve equations and inequalities graphically. **HSA.SSE.B:** Write expressions in equivalent forms to solve problems. **HSF.IF.B:** Interpret functions that arise in applications in terms of the context. **HSF.IF.C:** Analyze functions using different representations.	• CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Polynomials and rational functions can be used to model a wide variety of real-world scenarios.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • What are some of the strategies we can use to find an unknown quantity and what

	are the advantages and disadvantages of these different strategies?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to recognize polynomial functions as a general family of functions that include quadratics and understand rational functions as a result of the division of polynomial functions.	1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations. 7. I can solve rational equations.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Mid-Test: Polynomials and Rational Functions Algebra 2 Unit 2 Mid-Unit Test 1. I can write equivalent expressions for polynomial and rational expressions. Test Question: #1, #5	Pre- Assessment: Algebra 2 Unit 2 Check-your-Readiness Ongoing Assessments:

2. I can determine the zeros and factors of a polynomial function from the equation or graph. Test Question: #2, #5, #6 3. I can determine the points of intersection of polynomial functions. Test Question: #3 4. I can sketch a graph of a polynomial function when given the equation of the function. Test Question: #7 5. I can analyze key graph features of polynomials and rational functions. Test Question: #4, #7 6. I can write and analyze polynomial and rational expressions to represent real-world situations. Test Question: #4 Unit 2 End of Unit Test: Polynomials and Rational Functions Algebra 2 Unit 2 End-of-Unit Test 1. I can write equivalent expressions for polynomial and rational expressions. Test Question: #1, #5 2. I can determine the zeros of a polynomial function from the equation or graph. Test Question: #3 5. I can analyze key graph features of polynomials and rational functions. Test Question: #3 6. I can write and analyze polynomial and rational expressions to represent real-world situations. Test Question: #2, #6, #7 7. I can solve rational equations. Test Question: #4	Algebra 2 Unit 2 Cool Downs Algebra 2 Unit 2 Curated Problem sets
Performance Task: The purpose of this lesson is for students to practice solving rational equations strategically and understand how certain steps in the solving process can lead to equations that are not equivalent to the initial equation. ● Transfer Skills: Critical Thinking ● Understandings: #1 ● Learning Targets: #7	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION

First Unit Topic: Polynomials	Estimated # of Lessons: 13
Learning Target(s): 1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions. 4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Consider the scenario of trying to maximize the volume of a box as an introduction to polynomial expressions. 2. Use graphing technology to observe a pattern between the factored form of a polynomial and its zeros. 3. Use graphing technology to begin analyzing end behavior and multiplicity of polynomials. 4. Use application problems as an introduction to dividing polynomial functions.	
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Second Unit Topic: Rational Functions	Estimated # of Lessons: 13
Learning Target(s): 1. I can write equivalent expressions for polynomial and rational expressions. 2. I can determine the zeros and factors of a polynomial function from the equation or graph. 3. I can determine the points of intersection of polynomial functions.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?

4. I can sketch a graph of a polynomial function when given the equation of the function. 5. I can analyze key graph features of polynomials and rational functions. 6. I can write and analyze polynomial and rational expressions to represent real-world situations. 7. I can solve rational equations.	● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Use additional application problems to begin modeling using division of polynomial functions, then transition this understanding into rational functions. 2. Use graphing technology to help analyze key graph features of rational functions. 3. Look at completed sample problems to being exploring useful strategies for solving rational equations.	
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Third Unit: Algebra2 IM2 Complex Numbers and Rational Exponents
Est. Time: 5 Weeks (19 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students use what they know about exponents and radicals to extend exponent rules to include rational exponents. Students will solve various equations involving squares and square roots, develop the concept of complex numbers by defining a new number whose square is -1, and use complex numbers to find solutions to quadratic equations.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSN-RN.A: Extend the properties of exponents to rational exponents.
HSA-REI.A: Understand solving equations as a process of reasoning and explain the reasoning.
HSN.CN.A: Perform arithmetic operations with complex numbers.
HSN.CN.B: Represent complex numbers and their operations on the complex plane.
HSA-REI.B: Solve equations and inequalities in one variable.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
MP #6: Attend to precision.
● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #7: Look for and make use of structure.
● SELF-DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #5: Use appropriate tools strategically.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>• Use radicals to rewrite expressions that have unit fraction exponents and other kinds of fractions for exponents.

• Connect the radical symbols with solutions to quadratic and cubic equations and determine the number of solutions the equation has.

• Imaginary and complex numbers are introduced and performing mathematical operations on complex numbers.

• Using knowledge of square roots and complex numbers, solve quadratic equations that have complex solutions. Practice completing the square and using the quadratic formula.</td><td>● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?

● What is a complex number and how can it be used to find solutions to quadratic equations?</td></tr>
</table>

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to know when equations involving rational exponents do not have real number solutions and instead have complex solutions.	1. I can write and interpret exponents that are positive and negative fractions 2. I can solve an equation with a square root, cube root or other radicals 3. I can identify and perform operations on an imaginary or complex number 4. I can find complex solutions to quadratic equations by using the completing the square process or quadratic formula

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 3 Test: Complex Numbers and Rational Exponents Algebra 2 Unit 3 End of Unit Assessment 1. I can write and interpret exponents that are positive and negative fractions TEST Question: #1 2. I can solve an equation with a square root, cube root or other radicals TEST Questions: #3, #6 3. I can identify and perform operations on an imaginary or complex number TEST Questions: #3, #4 4. I can find complex solutions to quadratic equations by using the completing the square process or quadratic formula TEST Questions: #2, #3, #5, #7	Pre- Assessment: Check your readiness Ongoing Assessments: Algebra 2 Unit 3 Cool Down Algebra 2 Unit 3 Curated Problem sets

Performance Task: Students begin by predicting how many real solutions a quadratic equation will have. Next, they create, and solve, their own quadratic equations that have either real or non-real solutions. They will need to see and make use of the structure of quadratic equations and build on the thinking where they use the quadratic formula to find non-real solutions to quadratic equations. Used to answer the essential question: What is a complex number and how can it be used to find solutions to quadratic equations? ● Transfer Skills: Communication, Critical Thinking and Self-Direction ● Understanding: #4 ● Learning Target: #4	Algebra 2 Unit 3 Real and Non-Real Solutions

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponent Properties	**Estimated # of Lessons: 5**
Learning Target(s): 1. I can write and interpret exponents that are positive and negative fractions.	**Essential Question:** ● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?
Learning Activities: 1. Evaluate expressions with integer exponents. 2. Calculate square and cube roots. 3. Write square and cube roots as exponents. 4. Interpret exponents that are fractions. 5. Interpret exponents that are negative fractions.	
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<table>
<tr><td>Second Unit Topic: Solving Equations with Square and Cube Roots.</td><td>Estimated # of Lessons: 4</td></tr>
<tr><td>Learning Target(s):

2. I can solve an equation with a square root, cube root or other radicals.</td><td>Essential Question:

● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Understand that the square root symbol means the positive square root.
2. Solve equations by squaring or finding square roots.
3. Solve equations by cubing or finding cube roots.
4. Solve equations with radicals in them.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
<tr><td>Third Unit Topic: A New Kind of Number</td><td>Estimated # of Lessons: 6</td></tr>
<tr><td>Learning Target(s):

3. I can identify and perform operations on an imaginary or complex number.</td><td>Essential Question:

● What is a complex number and how can it be used to find solutions to quadratic equations?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Represent $\sqrt{-1}$ and multiples of it.
2. Use i to solve equations.
3. Add complex numbers and calculate powers of imaginary numbers.
4. Multiply complex numbers.
5. Do arithmetic with complex numbers.
6. Find real and imaginary parts of complex numbers if I know enough about the numbers and their product.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

<table>
<tr><th>Fourth Unit Topic: Solving Quadratics with Complex Numbers</th><th>Estimated # of Lessons: 4</th></tr>
<tr><td>Learning Target(s):
4. I can find complex solutions to quadratic equations use the completing the square process or quadratic formula.</td><td>Essential Questions:
● How can previous knowledge of exponents and radicals be used to solve equations involving squares and square roots?
● What is a complex number and how can it be used to find solutions to quadratic equations?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Solve quadratic equations by completing the square or by using the quadratic formula.
2. Find complex solutions to quadratic equations by completing the square.
3. Find complex solutions to quadratic equations by using the quadratic formula.
4. Find complex solutions to quadratic equations.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Fourth Unit : Algebra 2 IM4 Exponential Functions and Equations
Est. Time: 7 Weeks (14 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will work with exponential relationships in the context of real-world problems and represent them with equations, tables, and graphs.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSF-LE.A: Construct and compare linear, quadratic, and exponential models and solve problems.
HSF-LE.B: Interpret expressions for functions in terms of the situation they model.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #2: Reason abstractly and quantitatively.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Exponential functions can be used to model situations in which a quantity changes by a constant factor and these functions can be represented in a variety of ways (table, graph, equations).

● Technology can be a good way to find an approximate solution to an exponential equation, but logarithms are necessary for finding exact solutions to some exponential problems.

● Logarithms can be used to model situations directly, in addition to as a tool for solving exponential equations.</td><td>● What is an exponential function and how are exponential functions utilized to model and predict behavior of real- world scenarios?

● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
</table>

How to recognize exponential situations in real-world contexts and use equations to model them. How to reason that exponential and logarithmic representations are connected and can be useful in different situations.	1. I can determine the growth/decay factor and rate for an exponential situation. 2. I can use exponential equations to make predictions in real-world contexts. 3. I can interpret exponential equations in context. 4. I can write exponential equations when given information in a word problem, table, or graph. 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs. 6. I can solve exponential equations using logarithms. 7. I can convert between exponential and logarithmic form. 8. I can interpret logarithmic functions in context. 9. I can evaluate logarithms.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 4 Mid-Unit Assessment: Exponential Functions
Unit 4 Mid-Unit Assessment
1. I can determine the growth/decay factor and rate for an exponential situation.
TEST Question: #1, #3, #6, #7

2. I can use exponential equations to make predictions in real-world contexts.
TEST Question: #4, #5, #6

3. I can interpret exponential equations in context.
TEST Question: #2, #6

4. I can write exponential equations when given information in a word problem, table, or graph.
TEST Question: #3, #4, #5, #7

Unit 4 End of Unit Assessment: Exponential and Logarithmic Functions
Unit 4 End-of-Unit Assessment
5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs.
TEST Question: #1, #5, #7

6. I can solve exponential equations using logarithms.
TEST Question: #2, #3, #5, #6, #7

7. I can convert between exponential and logarithmic form.
TEST Question: #2

8. I can interpret logarithmic functions in context.
TEST Question: #4

9. I can evaluate logarithms.
TEST Question: #1, #2, #4</td><td>Pre- Assessment:
Algebra 2 Unit 4 Check Your Readiness

Ongoing Assessments:
Algebra 2 Unit 4 Cooldowns

Algebra 2 Unit 4 Curated Problem Sets</td></tr>
<tr><td>Performance Task: Students will be introduced to two new real-world situations, pH and the Richter scale, in which an exponential/logarithmic</td><td></td></tr>
</table>

relationship is evident, but the exact model is not immediately obvious. Students will then work to develop functions that can model these situations, addressing the Essential Question: What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? ● Transfer Skills: Synthesize information to solve problems and defend claims. ● Understandings: #3 ● Learning Targets: #7, #8, #9	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponential Functions/Growth and Decay	**Estimated # of Lessons: 9**
Learning Target(s): 1. I can determine the growth/decay factor and rate for an exponential situation. 2. I can use exponential equations to make predictions in real-world contexts. 3. I can interpret exponential equations in context. 4. I can write exponential equations when given information in a word problem, table, or graph. 5. I can find or approximate the value of missing exponents using algebraic reasoning and/or graphs.	**Essential Questions:** ● What is a function and how are functions defined to model and predict behavior of real- world scenarios? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Analyze situations involving exponential growth or decay by identifying the growth/decay factor and noticing that exponents can be used to simplify computation. 2. Practice representing exponential situations using functions. Use these functions to make predictions about the situation. 3. Analyze exponential situations involving rational inputs (including negative values). Explain what these inputs and corresponding outputs represent in context. 4. Find missing exponent values using graphs and guess-and-check.	
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Second Unit Topic: Logarithms	Estimated # of Lessons: 5
Learning Target(s): 6. I can solve exponential equations using logarithms. 7. I can convert between exponential and logarithmic form. 8. I can interpret logarithmic functions in context. 9. I can evaluate logarithms.	**Essential Questions:** ● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? ● What are some of the strategies we can use to find an unknown quantity and what are the advantages and disadvantages of these different strategies?
Learning Activities: 1. Use a logarithm table to begin considering what a logarithm is. 2. Practice converting between logarithmic and exponential form. 3. Explore the scenario where a value grows by a tiny amount many times and use this to introduce the number e. 4. Investigate model sample problems to introduce solving exponential equations using logarithms. 5. Model situations using logarithms and consider how to connect these models to exponential situations.	
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COURSE NAME: Algebra 2 **Fifth Unit: Algebra 2 IM5 Transformations of Functions** **Est. Time: 5 Weeks (11 lessons, meets every other day)**	

OVERVIEW

In this unit, students will look at a variety of different functions and explore how they can be transformed to match certain situations and data sets. They will work with functions in the form of a graph, equation, and table, and see how changing the equation affects these other two forms.

STAGE 1 → IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	TRANSFER
CSDE Content Standards: **HSF-BF.A:** Build a function that models a relationship between two quantities. **HSF-BF.B:** Build new functions from existing functions.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #2: Reason abstractly and quantitatively. MP #4: Model with mathematics. MP #8: Look for and express regularity in repeated reasoning.

UNDERSTANDINGS	ESSENTIAL QUESTIONS
● Modifying a parent function using transformations can be an effective way to model a situation and/or data that is not perfectly represented by an equation.	● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to determine a potential sequence of transformations to turn one function into another.	1. I can shift a function vertically or horizontally by modifying its equation. 2. I can reflect a function across the x-axis or y-axis by modifying its equation. 3. I can scale the inputs or outputs of a function by modifying its equation.

	4. I can write a new equation to apply a sequence of transformations. 5. I can determine if a function is odd, even, or neither. 6. I can combine functions by adding, subtracting, multiplying, or dividing and use this to model situations. 7. I can model data and real-world situations by transforming a function.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 5 End of Unit Assessment: Transformations of Functions
Unit 5 End-of-Unit Assessment

1. I can shift a function vertically or horizontally by modifying its equation.
TEST Question: #1, #2

2. I can reflect a function across the x-axis or y-axis by modifying its equation.
TEST Question: #2

3. I can scale the inputs or outputs of a function by modifying its equation.
TEST Question: #2, #3

4. I can write a new equation to apply a sequence of transformations.
TEST Question: #1, #2

5. I can determine if a function is odd, even, or neither.
TEST Question: #5

6. I can combine functions by adding, subtracting, multiplying, or dividing and use this to model situations.
TEST Question: #3

7. I can model data and real-world situations by transforming a function.
TEST Question: #1, #6, #7</td><td>Pre-Assessment:
Algebra 2 Unit 5 Check Your Readiness

Ongoing Assessments:
Algebra 1 Unit 5 Cool Downs

Algebra 2 Unit 5 Curated Problem Sets</td></tr>
<tr><td>Performance Task: Students will be given a set of data and multiple functions to use as starting points. Their goal will be to apply transformations to the different functions in order to best model the data set. After transforming the different functions, students will analyze how good of a model each new function is.
● Transfer Skills: Critical Thinking
● Understandings: #1
● Learning Targets: #1, #2, #3, #4, #7</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Transformations of Functions</td><td>Estimated # of Lessons: 11</td></tr>
<tr><td>Learning Target(s):

1. I can shift a function vertically or horizontally by modifying its equation.

2. I can reflect a function across the x-axis or y-axis by modifying its equation.

3. I can scale the inputs or outputs of a function by modifying its equation.

4. I can write a new equation to apply a sequence of transformations.

5. I can determine if a function is odd, even, or neither.

6. I can combine functions by adding, subtracting, multiplying, or dividing and use this to model situations.

7. I can model data and real-world situations by transforming a function.</td><td>Essential Questions:

● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Use graphing technology to explore how different functions can be used to model the same data set. Consider which functions model the data more accurately.
2. Describe out loud how a starting function was modified in order to arrive at a new function. Based on your partner’s description, draw the new function.
3. Use graphs and tables to explore vertical and horizontal shifts of functions.
4. Complete a table from a graph to determine how changing an equation can reflect a function across an axis.</td></tr>
</table>

5. Observe that some functions are symmetrical with respect to an axis, then determine how to identify this based on the equation. 6. Using the context of books owned and population, explore why combining functions can give useful new functions.
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2   Sixth Unit: Algebra 2 IM6   Trigonometric Functions
Est. Time: 6 Weeks (19 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students are introduced to trigonometric functions. In addition, students are asked to consider periodic functions, that is, functions whose output values repeat at regular intervals.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSF.TF.A.1: Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle
HSF.TF.B.5: Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline</td><td>● RESPONSIBLE CITIZENSHIP: Use technology to ethically promote positive, reliable and factual information.
MP #4: Model with mathematics.
● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Real-world problems involving periodic behavior can be modelled using trigonometric functions.</td><td>● How are trigonometric functions used to model periodic behaviors?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>How to define, graph and analyze trigonometric functions.</td><td>1. I can find the period of a trigonometric function using an equation or graph.
2. I can identify the midline, amplitude, and horizontal translation of a trigonometric function given a graph or equation.
3. I can write a trigonometric function to represent situations with different amplitudes and midlines.</td></tr>
</table>

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 End of Unit Assessment: Trigonometric Functions Algebra 2 unit 6 test 1. I can find the period of a trigonometric function using an equation or graph. TEST Questions: #1, #4, #7 2. I can identify the midline, amplitude, and horizontal translation of a trigonometric function given a graph or equation. TEST Questions: #2, #3, #4 3. I can write a trigonometric function to represent situations with different amplitudes and midlines. TEST Questions: #5, #6, #7	Pre- Assessment: Algebra 2 Unit 6 Check Your Readiness Ongoing Assessments: Algebra 2 Unit 6 Cool Downs Algebra 2 Unit 4 Curated Problem Sets
Performance Task: The goal of this lesson is for students to develop their skills modeling periodic data. Essential Question: How are trigonometric functions used to model periodic behaviors? ● Transfer Skills: Responsible Citizenship ● Understandings: #1 ● Learning Targets: #1, #2, #3	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Polynomials	**Estimated # of Lessons: 3**
Learning Target(s): 1. I can find the period of a trigonometric function using an equation or graph	**Essential Questions:** ● How are trigonometric functions used to model periodic behaviors?
Learning Activities: 1. Analyzing trigonometric functions and their relationship with the unit circle	

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Second Unit Topic: Rational Functions	Estimated # of Lessons: 3
Learning Target(s): 2. I can identify the midline, amplitude, and horizontal translation of a trigonometric function given a graph or equation. 3. I can write a trigonometric function to represent situations with different amplitudes and midlines.	**Essential Questions:** ● How are trigonometric functions used to model periodic behaviors?
Learning Activities: 1. Analyzing trigonometric functions and their midlines, amplitudes, periods, frequencies and graphs	
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<table>
<tr><td colspan="2">COURSE NAME: Algebra 2 Seventh Unit: Algebra 2 IM 7 Statistical Inferences
Est. Time: 5 Weeks (16 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit students will build on their middle school skills of collecting samples from a population and using information about those samples to estimate characteristics for the population. Here students will explore the normal distribution and apply understanding of the distribution to provide estimates with a margin of error. This unit will also look at experimental studies, observational studies, and surveys.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSS-IC.A: Understand and evaluate random processes underlying statistical experiments.
HSS-IC.B: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
HSS-ID.A: Summarize, represent, and interpret data on a single count or measurement variable.</td><td>CRITICAL THINKING: Identify a problem, ask key questions and make predictions.
MP #1: Make sense of problems and persevere in solving them.
MP #2 Reason abstractly and quantitatively.
COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #3 Construct viable arguments and critique the reasoning of others.
RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #3 Construct viable arguments and critique the reasoning of others.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Use data collected from a sample of a population in question. A process of randomization is used to reduce the amount of bias in the sample. Create statistical measures from this population and use a margin of error to estimate how much the statistics will vary.
Make inferences using the statistics and margin of error found from the sample. Use the inferences to answer questions about the normal distribution of the population.</td><td>How can statistics be collected, displayed, and analyzed in an unbiased fashion?
How can an event be both random and predictable?</td></tr>
</table>

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to use different statistical questions based on the type of study. Emphasize the importance of random selection for gathering a sample for surveys and observational studies and the importance of random assignment in experimental studies. How to analyze data by examining the shapes of distributions and focusing on the normal distribution as a common and standardized shape. Data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. How to analyze the results from experimental studies to estimate population means and proportions with a margin of error based on data from surveys. How to determine whether experimental data is likely due to the chance arrangement of groups or the experimental treatment.	1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. 2. I can understand and be able to explain the importance of random selection for gathering a sample for surveys and observational studies. 3. I can understand the importance of random assignment in experimental studies. 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. 6. I can analyze the results from experimental studies. 7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance

	arrangement of the groups or the experimental treatment.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 Mid-Unit Assessment: Statistical Inferences Algebra 2 Unit 7 Mid-Unit Assessment 1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. Test Question #5, #7 2. I can understand and be able to describe the importance of random selection for gathering a sample for surveys and observational studies. Test Question #6 3. I can understand and be able to describe the importance of random assignment in experimental studies. Test Question #1, #6, #7 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. Test Questions: #2, #3, #7 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. Test Questions: #3, #7 6. I can analyze the results from experimental studies. Test Questions: #4, #7	Pre- Assessment: Algebra 2 Unit 7 Check your Readiness Ongoing Assessment: Algebra 1 Unit 7 Cool Downs Algebra 2 Unit 7 Curated Problem Sets

7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. Test Question: not yet addressed. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. Test Question #4 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Test Question #5 Unit 7 End of Unit Assessment: Statistical Inferences Algebra 2 Unit 7 End of Unit Assessment 1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. Test Question #7 2. I can understand and be able to describe the importance of random selection for gathering a sample for surveys and observational studies. Test Question #5 3. I can understand and be able to describe the importance of random assignment in experimental studies. Test Question #3, #4 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. Test Question #7 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional	

information such as the proportion of data expected within certain intervals. Test Question #7 6. I can analyze the results from experimental studies. Test Question #3, 5 7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. Test Question #1, #2, #6 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. Test Question #2, #4 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Test Question #5, #7	
Performance Task: Students collect data from an experiment involving their heart rates and analyze the data using randomization distributions. An understanding of the normal distribution is used to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Used to answer the essential question: How can an event be both random and predictable? • Transfer Skills: Research and Understanding • Understandings: #2 • Learning Target: #9	Algebra 2 Unit 7 Lesson 16 Heart Rates

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Study Types	**Estimated # of Lessons: 3**
Learning Target(s):	**Essential Question:**

1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. 2. I can understand and be able to explain the importance of random selection for gathering a sample for surveys and observational studies. 3. I can understand and be able to explain the importance of random assignments in experimental studies.	• How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Decide if a study is good or bad based on evidence. 2. Recognize the difference between a survey, observational study, or experimental study. 3. Understand why randomization is important in the design of a study. 4. Describe the different purposes for each type of study design (survey, observational study, or experimental study). 5. Recognize the difference between a survey, observational study, or experimental study. 6. Understand that the choice of the design for a study will impact what questions can be answered. 7. Recognize that the way a sample is chosen matters, and that random samples have less bias.	
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Second Unit Topic: Distributions	**Estimated # of Lessons: 4**
Learning Target(s): 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals.	**Essential Question:** • How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities: 1. Describe a distribution using the characteristics of its shape, center, and spread. 2. Use the standard deviation to describe the variability in a distribution. 3. Calculate a relative frequency and create a relative frequency histogram. 4. Know that a normal curve is defined using the mean and standard deviation. 5. Calculate a proportion of a set of data that matches a shaded area in a histogram. 6. Recognize the patterns of proportions that occur in distributions that are approximately normal in shape. 7. Use the mean and standard deviation of a normally distributed data set to estimate intervals when given a proportion. 8. Use the mean and standard deviation of a normally distributed data set to estimate proportions.	
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Third Unit Topic: Not all Samples are the Same	**Estimated # of Lessons: 5**
Learning Target(s): 6. I can analyze the results from experimental studies. 7. I can understand what margin of error means and be able to estimate using the mean and standard deviation. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section.	**Essential Question:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Justify a mathematical claim using evidence. 2. Use mathematical evidence to find the difference between when outcomes are unfair or due to random chance. 3. Understand why it is important to be skeptical of data that seems unfair. 4. Estimate the margin of error using the mean and standard deviation. 5. Understand that sample means, and proportions can be representative of the overall population. 6. Understand that sample means and proportions vary.	

7. Estimate the margin of error using standard deviation.
8. Understand that a larger margin of error means more variability, and I should be less confident in my estimate of the population mean.
9. Understand that a smaller margin of error means more variability, and I can be more confident in my estimate of the population mean.
10. Understand that different samples from the same population can still have different statistics.
11. Describe why a larger sample size usually leads to a smaller margin of error.
12. Understand that sample size influences the size of the margin of error for a data set.
13. Calculate the mean and standard deviation of sample means and use the information to estimate the margin of error.
14. Understand that sample means that are normally distributed follow the same pattern as sample proportions.

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Fourth Unit Topic: Analyzing Experimental Data	**Estimated # of Lessons: 4**
Learning Target(s): 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment.	**Essential Questions:** ● How can an event be both random and predictable?

Learning Activities:

1. Find the difference between two treatment means and use a randomization distribution to determine whether the result occurred by random chance.
2. Understand why randomization is important in the design of a study.
3. Calculate the difference in means between two groups.
4. Justify whether there is evidence for a statistical claim by using proportions in the normal distribution.
5. Understand that the difference in means can be modeled by a distribution that is approximately normal in shape.
6. Use a randomization distribution to determine whether a treatment was the cause of the results of an experiment, or if the results are due to the random assignment of the groups.
7. Understand why it is important to question the results of an experiment.

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COURSE NAME: Coastal Navigation First Unit: Finding the Boat's Position Est. Time: 16 Weeks (12 Lessons, meets every other day)	
OVERVIEW *In this unit, students will build upon their previous knowledge of algebra and geometry to find the position of a boat on a nautical chart.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-MG.A:** Apply geometric concepts in modeling situations. **HSG-SRT.B.5**: Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **HSG-SRT.C.8:** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **HSA-REI.B:** Solve equations and inequalities in one variable. **HSA-CED.A**: Create equations that describe numbers or relationships. **HSN-VM.B.4:** Add and subtract vectors.	● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #4: Model with mathematics. MP #5: Use appropriate tools strategically. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Knowing the position of a boat on the water is essential for everyone's safety.	● How can algebra and geometry be used to find the position of a boat?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can calculate distance, speed, or time using the dead reckoning formula.

How to find the position of a boat through the use of dead reckoning and fixes.	2. I can convert from true course to compass course, and vice versa, using a deviation table. 3. I can determine a boat's position through beam bearings, 2 bearing fixes, 3 bearing fixes, and running fixes. 4. I can determine a boat's position when presented with the effect of current. 5. I can determine a boat's position by using a sextant and spherical trigonometry depending on the altitude of the local noon sun.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Assessment 1 1. I can calculate distance, speed, or time using the dead reckoning formula. Test Questions: #1 2. I can convert from true course to compass course, and vice versa, using a deviation table. Test Questions: #1, 2, 3, 4, 5, 6 3. I can determine a boat's position through beam bearings, 2 bearing fixes, 3 bearing fixes, and running fixes. Test Questions: #2, 4, 5, 6 4. I can determine a boat's position when presented with the effect of current. Test Questions: #3, 5	Pre- Assessment: Ongoing Assessments: Unit 1.1 Unit 1.2
Unit 1 Assessment 2 5. I can determine a boat's position by using a sextant and spherical trigonometry depending on the altitude of the local noon sun. Test Questions: #1	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Using Aids to Navigation to Find Boat's Position.	**Estimated # of Lessons: 11**
1. I can calculate distance, speed, or time using the dead reckoning formula.	**Essential Questions:**

2. I can convert from true course to compass course, and vice versa, using a deviation table. 3. I can determine a boat's position through beam bearings, 2 bearing fixes, 3 bearing fixes, and running fixes. 4. I can determine a boat's position when presented with the effect of current.	● How can algebra and geometry be used to find the position of a boat?

Learning Activities:

1. Given the dead reckoning formula, calculate distance, speed, or time.
2. Given a true course, convert to compass course.
3. Given two or three aids to navigation, perform a two- or three-bearing fix to determine position.
4. Given one aid to navigation, perform a beam bearing to determine position.
5. Given one aid to navigation, constant course, and constant speed, perform a running fix to determine position.
6. Given set and drift of current, calculate new course and speed in order to track original course.

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Second Unit Topic: Using Local Area Noon Sun to Find Boat's Position	**Estimated # of Lessons: 1**
Learning Target(s): 5. I can determine a boat's position by using a sextant and spherical trigonometry depending on the altitude of the local noon sun.	**Essential Questions:** ● How can algebra and geometry be used to find the position of a boat?

Learning Activities:

1. Given a sextant, determine the altitude of the local area noon sun.
2. Given declination of sun and calculated zenith distance, determine latitude.
3. Given a course and speed, use trigonometry to calculate minutes of latitude traveled to determine current latitude.

4. Given Greenwich Hour Angle, zenith distance, declination of sun, use spherical trigonometry to calculate current longitude.
Basic Coastal Navigation 2nd Edition, Frank J. Larkin

COURSE NAME: Coastal Navigation Second Unit: Using Radar Plotting to Avoid Collisions Est. Time: 4 Weeks (1 Lesson, meets every other day)	
OVERVIEW *In this unit, students will build upon their previous knowledge of algebra and geometry to determine the new course and speed needed to avoid a collision.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-MG.A:** Apply geometric concepts in modeling situations. **HSA-REI.B:** Solve equations and inequalities in one variable. **HSN-VM.B.4:** Add and subtract vectors.	● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #4: Model with mathematics. MP #5: Use appropriate tools strategically. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Knowing how to read a radar display is essential in avoiding a boat collision.	● How can algebra and geometry be used to avoid a boat collision?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use a radar display to determine a new course or speed for the boat to avoid a collision.	1. I can calculate the distance and time of the closest point of approach for the other vessel. 2. I can use vectors to determine the other vessel's current course and speed. 3. I can use vectors to determine the new course or speed needed to avoid a collision by at least two nautical miles.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Assessment 1 Unit 2 Assessment 1 1. I can calculate the distance and time of the closest point of approach for the other vessel. Test Question: #1 2. I can use vectors to determine the other vessel's current course and speed. Test Question: #1 3. I can use vectors to determine the new course or speed needed to avoid a collision by at least two nautical miles. Test Question: #1	Pre- Assessment: Ongoing Assessments: Unit 2.1

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Radar Plotting.	**Estimated # of Lessons: 1**
1. I can calculate the distance and time of the closest point of approach for the other vessel. 2. I can use vectors to determine the other vessel's current course and speed. 3. I can use vectors to determine the new course or speed needed to avoid a collision by at least two nautical miles.	**Essential Questions:** ● How can algebra and geometry be used to avoid a boat collision?
Learning Activities: 1. Given another vessel's bearing and range from two different times, calculate the time and distance to the closest point of approach, the vessel's current course and speed, and the new course or speed necessary to avoid collision.	

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COURSE NAME: Coastal Navigation **First Unit: Finding the Boat's Position** **Est. Time: 16 Weeks (12 Lessons, meets every other day)**	
OVERVIEW *In this unit, students will build upon their previous knowledge of algebra and geometry to find the position of a boat on a nautical chart.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-MG.A:** Apply geometric concepts in modeling situations. **HSG-SRT.B.5**: Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **HSG-SRT.C.8:** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **HSA-REI.B:** Solve equations and inequalities in one variable. **HSA-CED.A**: Create equations that describe numbers or relationships. **HSN-VM.B.4:** Add and subtract vectors.	• CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #4: Model with mathematics. MP #5: Use appropriate tools strategically. • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Knowing the position of a boat on the water is essential for everyone's safety.	• How can algebra and geometry be used to find the position of a boat?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can calculate distance, speed, or time using the dead reckoning formula.

How to find the position of a boat through the use of dead reckoning and fixes.	2. I can convert from true course to compass course, and vice versa, using a deviation table. 3. I can determine a boat’s position through beam bearings, 2 bearing fixes, 3 bearing fixes, and running fixes. 4. I can determine a boat’s position when presented with the effect of current. 5. I can determine a boat’s position by using a sextant and spherical trigonometry depending on the altitude of the local noon sun.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Assessment 1 1. I can calculate distance, speed, or time using the dead reckoning formula. Test Questions: #1 2. I can convert from true course to compass course, and vice versa, using a deviation table. Test Questions: #1, 2, 3, 4, 5, 6 3. I can determine a boat's position through beam bearings, 2 bearing fixes, 3 bearing fixes, and running fixes. Test Questions: #2, 4, 5, 6 4. I can determine a boat's position when presented with the effect of current. Test Questions: #3, 5	Pre- Assessment: Ongoing Assessments: Unit 1.1 Unit 1.2
Unit 1 Assessment 2 5. I can determine a boat's position by using a sextant and spherical trigonometry depending on the altitude of the local noon sun. Test Questions: #1	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Using Aids to Navigation to Find Boat's Position.	**Estimated # of Lessons: 11**
1. I can calculate distance, speed, or time using the dead reckoning formula.	**Essential Questions:**

2. I can convert from true course to compass course, and vice versa, using a deviation table. 3. I can determine a boat's position through beam bearings, 2 bearing fixes, 3 bearing fixes, and running fixes. 4. I can determine a boat's position when presented with the effect of current.	● How can algebra and geometry be used to find the position of a boat?

Learning Activities:

1. Given the dead reckoning formula, calculate distance, speed, or time.
2. Given a true course, convert to compass course.
3. Given two or three aids to navigation, perform a two- or three-bearing fix to determine position.
4. Given one aid to navigation, perform a beam bearing to determine position.
5. Given one aid to navigation, constant course, and constant speed, perform a running fix to determine position.
6. Given set and drift of current, calculate new course and speed in order to track original course.

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Second Unit Topic: Using Local Area Noon Sun to Find Boat's Position	**Estimated # of Lessons: 1**
Learning Target(s): 5. I can determine a boat's position by using a sextant and spherical trigonometry depending on the altitude of the local noon sun.	**Essential Questions:** ● How can algebra and geometry be used to find the position of a boat?

Learning Activities:

1. Given a sextant, determine the altitude of the local area noon sun.
2. Given declination of sun and calculated zenith distance, determine latitude.
3. Given a course and speed, use trigonometry to calculate minutes of latitude traveled to determine current latitude.

4. Given Greenwich Hour Angle, zenith distance, declination of sun, use spherical trigonometry to calculate current longitude.
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COURSE NAME: Coastal Navigation Second Unit: Using Radar Plotting to Avoid Collisions Est. Time: 4 Weeks (1 Lesson, meets every other day)	
OVERVIEW *In this unit, students will build upon their previous knowledge of algebra and geometry to determine the new course and speed needed to avoid a collision.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-MG.A:** Apply geometric concepts in modeling situations. **HSA-REI.B:** Solve equations and inequalities in one variable. **HSN-VM.B.4:** Add and subtract vectors.	● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #4: Model with mathematics. MP #5: Use appropriate tools strategically. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Knowing how to read a radar display is essential in avoiding a boat collision.	● How can algebra and geometry be used to avoid a boat collision?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use a radar display to determine a new course or speed for the boat to avoid a collision.	1. I can calculate the distance and time of the closest point of approach for the other vessel. 2. I can use vectors to determine the other vessel's current course and speed. 3. I can use vectors to determine the new course or speed needed to avoid a collision by at least two nautical miles.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 2 Assessment 1
Unit 2 Assessment 1

1. I can calculate the distance and time of the closest point of approach for the other vessel.
Test Question: #1
2. I can use vectors to determine the other vessel's current course and speed.
Test Question: #1
3. I can use vectors to determine the new course or speed needed to avoid a collision by at least two nautical miles.
Test Question: #1</td><td>Pre- Assessment:

Ongoing Assessments:
Unit 2.1</td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Radar Plotting.</td><td>Estimated # of Lessons: 1</td></tr>
<tr><td>1. I can calculate the distance and time of the closest point of approach for the other vessel.
2. I can use vectors to determine the other vessel's current course and speed.
3. I can use vectors to determine the new course or speed needed to avoid a collision by at least two nautical miles.</td><td>Essential Questions:
● How can algebra and geometry be used to avoid a boat collision?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Given another vessel's bearing and range from two different times, calculate the time and distance to the closest point of approach, the vessel's current course and speed, and the new course or speed necessary to avoid collision.</td></tr>
</table>

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COURSE NAME: Probability and Statistics Unit 1 Title: Statistics Est. Time: 12 Weeks (14 Lessons, class meets every other day)	
OVERVIEW *In this unit, students will build upon their previous knowledge of statistics to further develop the skills of collecting, displaying, and analyzing statistics in an unbiased fashion. Students further develop their capacity to analyze real world problems that utilize statistics as basis for a point of view.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSS-IC.A:** Understand and evaluate random processes underlying statistical experiments. **HSS-IC.B**: Make inferences and justify conclusions from sample surveys, experiments, and observational studies. **HSS-ID.A:** Summarize, represent, and interpret data on a single count or measurement variable.	● RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information. MP #5: Use appropriate tools strategically. ● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #4: Model with mathematics. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Statistics are used to influence perceptions concerning a certain topic.	● How can statistics be collected, displayed, and analyzed in an unbiased fashion?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can tell the difference between qualitative and quantitative data and if quantitative decipher whether the data is discrete or continuous.

How to use statistics to analyze real world scenarios.	2. I can tell the difference between random, systematic, stratified, cluster, and convenience sampling. 3. I can decipher if the statistics being presented are a misuse of statistics. 4. I can place a variable in the appropriate level of measurement (nominal, ordinal, interval, or ratio) 5. I can create a histogram, frequency polygon, ogive, bar graph, pie graph, pareto chart, time series plot, and box plot to represent data. 6. I can calculate mean, median, mode, standard deviation, interquartile range, and variance for a set of data. 7. I can create graphic representations of data and calculate statistics using technology. 8. I can find values that are outliers, investigate their source, and figure out what to do with them. 9. I can determine the position of a data point among the larger data set.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 1 Assessment 1
Unit 1 Assessment 1

1. I can tell the difference between qualitative and quantitative data and if quantitative decipher whether the data is discrete or continuous.
Test Question: #9, 10, 16
2. I can tell the difference between random, systematic, stratified, cluster, and convenience sampling.
Test Question: #18, 19, 20, 21

3. I can decipher if the statistics being presented are a misuse of statistics.
Test Question: #26, 27, 28, 29, 30

4. I can place a variable in the appropriate level of measurement (nominal, ordinal, interval, or ratio)
Test Question: #11, 12, 13, 14, 15

Unit 1 Assessment 2
Unit 1 Assessment 2

5. I can use a histogram, frequency polygon, ogive, bar graph, pie graph, pareto chart, time series plot, and box plot to represent data.

Test Question: #1, 2, 3, 4, 5, 6, 7

Unit 1 Assessment 3
Unit 1 Assessment 3

6. I can calculate mean, median, mode, standard deviation, interquartile range, and variance for a set of data.
Test Questions: #1, 2, 7
7. I can create graphic representations of data and calculate statistics using technology.
Test Questions: #1, 2, 3, 4, 5, 6, 7

8. I can find values that are outliers, investigate their source, and figure out what to do with them.
Test Questions: #7

9. I can determine the position of a data point among the larger data set.</td><td>Pre- Assessment:

Ongoing Assessments:
Unit 1.1
Unit 1.2
Unit 1.3</td></tr>
</table>

Test Questions: #3, 4, 5, 6, 7	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: The Nature of Probability and Statistics.	**Estimated # of Lessons: 4**
1. I can tell the difference between qualitative and quantitative data and if quantitative decipher whether the data is discrete or continuous. 2. I can tell the difference between random, systematic, stratified, cluster, and convenience sampling. 3. I can decipher if the statistics being presented are a misuse of statistics. 4. I can place a variable in the appropriate level of measurement (nominal, ordinal, interval, or ratio)	**Essential Questions:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Identify the difference between descriptive and inferential statistics. 2. Given a variable, determine if it is qualitative or quantitative and if quantitative decipher if the variable is discrete or continuous. 3. Given a variable, determine on which measurement scale the variable belongs (nominal, ordinal, interval, or ratio). 4. Given a statistical question, determine which sampling method would produce results that would best represent the population.	
Elementary Statistics 8th Edition, Allan G. Bluman	

Second Unit Topic: Frequency Distributions and Graphs	**Estimated # of Lessons: 3**
Learning Target(s): 5. I can use a histogram, frequency polygon, ogive, bar graph, pie graph, pareto chart, time series plot, and box plot to represent data.	**Essential Questions:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities:

1. Given raw data, construct a categorical or grouped frequency distribution.
2. Given quantitative data, construct a histogram, frequency polygon, and ogive.
3. Given qualitative data, construct a bar graph, Pareto chart, time series chart, and pie graph.

Elementary Statistics 8th Edition, Allan G. Bluman

Third Unit Topic: Analyzing Data	**Estimated # of Lessons: 3**
Learning Target(s): 6. I can calculate mean, median, mode, standard deviation, interquartile range, and variance for a set of data. 7. I can create graphic representations of data and calculate statistics using technology. 8. I can find values that are outliers, investigate their source, and figure out what to do with them. 9. I can determine the position of a data point among the larger data set.	**Essential Questions:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities:

1. Given raw data, calculate the measures of central tendency (mean, median, mode, weighted mean and midrange).

2. Given raw data, calculate the measures of spread (variance, standard deviation).

3. Given a data point, determine its position among the data set through z-scores, percentile graphs, or quartiles. 4. Given a data set, determine whether the data contains outliers or extremes by constructing a box plot.
Elementary Statistics 8th Edition, Allan G. Bluman

<table>
<tr><td colspan="2">COURSE NAME: Probability and Statistics Unit 2 Title: Probability
Est. Time: 8 Weeks (9 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will build upon their previous knowledge of probability to determine the likelihood of an event occurring within real world situations.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSS-MD.A: Calculate expected values and use them to solve problems.
HSS-MD.B: Use probability to evaluate outcomes of decisions.
HSS-IC.A: Understand and evaluate random processes underlying statistical experiments.
HSS-CP.A: Understand independence and conditional probability and use them to interpret data.
HSS-CP.B: Use the rules of probability to compute probabilities of compound events in a uniform probability model.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
MP #1: Make sense of problems and persevere in solving them.
MP #4: Model with mathematics.
MP #5: Use appropriate tools strategically.
MP #7: Look for and make use of structure.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Probability is used to predict the likelihood that a random event will occur.</td><td>● How can an event be both random and predictable?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td></td><td>1. I can find or estimate the probability using a model or data from a chance experiment.
2. I can create organized lists, tables, and tree diagrams to calculate probabilities.</td></tr>
</table>

How to use probability to predict the likelihood of the occurrence of real-world random events.	3. I can use information in a two-way table to find relative frequencies and to estimate probability. 4. I can calculate probabilities using the addition and multiplication rules. 5. I can use the fundamental counting principle, factorials, permutations, and combinations to determine the number of possible outcomes of an event. 6. I can calculate the expected value of an event. 7. I can use binomial distributions to calculate the probabilities of a binomial experiment. 8. I can use normal distributions and the central limit theorem to find probabilities with normally distributed data.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Assessment 1 Unit 2 Assessment 1 1. I can find or estimate the probability using a model or data from a chance experiment. Test Questions: #1, 2, 3, 4, 5, 14, 24 2. I can create organized lists, tables, and tree diagrams to calculate probabilities. Test Questions: #13 3. I can use information in a two-way table to find relative frequencies and to estimate probability. Test Questions: #6 4. I can calculate probabilities by implementing the addition and multiplication rules. Test Questions: #8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 25 5. I can use the fundamental counting principle, factorials, permutations, and combinations to determine the number of possible outcomes of an event. Test Questions: #7, 19, 20, 21, 22, 23, 24, 26, 27 Unit 2 Assessment 2 Unit 2 Assessment 2 6. I can calculate the expected value of an event. Test Questions: #1, 2, 6 7. I can use binomial distributions to calculate the probabilities of a binomial experiment. Test Questions: #3, 4, 5 8. I can use normal distributions and the central limit theorem to find probabilities with normally distributed data. Test Questions: #7, 8, 9, 10, 11	Pre- Assessment: Ongoing Assessments: Unit 2.1

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Classical and Empirical Probability	**Estimated # of Lessons: 5**
1. I can find or estimate the probability using a model or data from a chance experiment. 2. I can create organized lists, tables, and tree diagrams to calculate probabilities. 3. I can use information in a two-way table to find relative frequencies and to estimate probability. 4. I can calculate probabilities by implementing the addition and multiplication rules. 5. I can use the fundamental counting principle, factorials, permutations, and combinations to determine the number of possible outcomes of an event.	**Essential Questions:** ● How can an event be both random and predictable?
Learning Activities: 1. Given an experiment, write out the corresponding sample space. 2. Given an event, calculate the probability of the event occurring. 3. Given an event, calculate the probability of the complementary event occurring. 4. Given a compound event, which is or is not mutually exclusive, calculate the probability of the event occurring using the addition rule of probability. 5. Given a compound event, which is independent or dependent, calculate the probability of the event occurring using the multiplication rule of probability. 6. Given a real-world scenario, calculate the number of possible outcomes using the fundamental counting principle, factorials, permutations or combinations.	
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Second Unit Topic: Probability Distributions	**Estimated # of Lessons: 4**
Learning Target(s): 6. I can calculate the expected value of an event.	**Essential Questions:** ● How can an event be both random and predictable?

7. I can use binomial distributions to calculate the probabilities of a binomial experiment. 8. I can use normal distributions and the central limit theorem to find probabilities with normally distributed data.	

Learning Activities:

1. Given an event, construct the appropriate probability distribution.
2. Given a real-world situation, determine the expected value of the event occurring.
3. Given an experiment which fits the criteria to be classified as binomial find the probability of an event, within that experiment, occurring.
4. Given a real-world scenario where the data fits a normal distribution calculate the probability of an event occurring.

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COURSE NAME: Probability and Statistics Unit 1 Title: Statistics Est. Time: 20 Weeks (12 Lessons, class meets every other day)	
OVERVIEW *In this unit, students will build upon their previous knowledge of statistics to further develop the skills of collecting, displaying, and analyzing statistics in an unbiased fashion. Students further develop their capacity to analyze real world problems that utilize statistics as basis for a point of view.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSS-IC.A:** Understand and evaluate random processes underlying statistical experiments. **HSS-IC.B**: Make inferences and justify conclusions from sample surveys, experiments, and observational studies. **HSS-ID.A:** Summarize, represent, and interpret data on a single count or measurement variable.	● RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information. MP #5: Use appropriate tools strategically. ● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #4: Model with mathematics. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Statistics are used to influence perceptions concerning a certain topic.	● How can statistics be collected, displayed, and analyzed in an unbiased fashion?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can tell the difference between qualitative and quantitative data and if quantitative decipher whether the data is discrete or continuous.

How to use statistics to analyze real world scenarios.	2. I can tell the difference between random, systematic, stratified, cluster, and convenience sampling. 3. I can decipher if the statistics being presented are a misuse of statistics. 4. I can place a variable in the appropriate level of measurement (nominal, ordinal, interval, or ratio) 5. I can create a histogram, frequency polygon, ogive, bar graph, pie graph, pareto chart, time series plot, and box plot to represent data. 6. I can calculate mean, median, mode, standard deviation, interquartile range, and variance for a set of data. 7. I can create graphic representations of data and calculate statistics using technology. 8. I can find values that are outliers, investigate their source, and figure out what to do with them. 9. I can determine the position of a data point among the larger data set.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 1 Assessment 1

1. I can tell the difference between qualitative and quantitative data and if quantitative decipher whether the data is discrete or continuous.
Test Question: #9, 10, 16
2. I can tell the difference between random, systematic, stratified, cluster, and convenience sampling.
Test Question: #18, 19, 20, 21

3. I can decipher if the statistics being presented are a misuse of statistics.
Test Question: #26, 27, 28, 29, 30

4. I can place a variable in the appropriate level of measurement (nominal, ordinal, interval, or ratio)
Test Question: #11, 12, 13, 14, 15

Unit 1 Assessment 2

5. I can use a histogram, frequency polygon, ogive, bar graph, pie graph, pareto chart, time series plot, and box plot to represent data.

Test Question: #1, 2, 3, 4, 5, 6, 7

Unit 1 Assessment 3

6. I can calculate mean, median, mode, standard deviation, interquartile range, and variance for a set of data.
Test Questions: #1, 2, 7
7. I can create graphic representations of data and calculate statistics using technology.
Test Questions: #1, 2, 3, 4, 5, 6, 7

8. I can find values that are outliers, investigate their source, and figure out what to do with them.
Test Questions: #7

9. I can determine the position of a data point among the larger data set.

Test Questions: #3, 4, 5, 6, 7</td><td>Pre- Assessment:

Ongoing Assessments:
Unit 1.1
Unit 1.2
Unit 1.3</td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: The Nature of Probability and Statistics.	**Estimated # of Lessons: 4**
1. I can tell the difference between qualitative and quantitative data and if quantitative decipher whether the data is discrete or continuous. 2. I can tell the difference between random, systematic, stratified, cluster, and convenience sampling. 3. I can decipher if the statistics being presented are a misuse of statistics. 4. I can place a variable in the appropriate level of measurement (nominal, ordinal, interval, or ratio)	**Essential Questions:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Identify the difference between descriptive and inferential statistics. 2. Given a variable, determine if it is qualitative or quantitative and if quantitative decipher if the variable is discrete or continuous. 3. Given a variable, determine on which measurement scale the variable belongs (nominal, ordinal, interval, or ratio). 4. Given a statistical question, determine which sampling method would produce results that would best represent the population.	
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Second Unit Topic: Frequency Distributions and Graphs	**Estimated # of Lessons: 3**
Learning Target(s): 5. I can use a histogram, frequency polygon, ogive, bar graph, pie graph, pareto chart, time series plot, and box plot to represent data.	**Essential Questions:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities:

1. Given raw data, construct a categorical or grouped frequency distribution.
2. Given quantitative data, construct a histogram, frequency polygon, and ogive.
3. Given qualitative data, construct a bar graph, Pareto chart, time series chart, and pie graph.

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Third Unit Topic: Analyzing Data	**Estimated # of Lessons: 3**
Learning Target(s): 6. I can calculate mean, median, mode, standard deviation, interquartile range, and variance for a set of data. 7. I can create graphic representations of data and calculate statistics using technology. 8. I can find values that are outliers, investigate their source, and figure out what to do with them. 9. I can determine the position of a data point among the larger data set.	**Essential Questions:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities:

1. Given raw data, calculate the measures of central tendency (mean, median, mode, weighted mean and midrange).

2. Given raw data, calculate the measures of spread (variance, standard deviation).

3. Given a data point, determine its position among the data set through z-scores, percentile graphs, or quartiles.

4. Given a data set, determine whether the data contains outliers or extremes by constructing a box plot.
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COURSE NAME: Probability and Statistics Unit 2 Title: Probability Est. Time: 8 Weeks (9 Lessons, class meets every other day)	
OVERVIEW *In this unit, students will build upon their previous knowledge of probability to determine the likelihood of an event occurring within real world situations.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSS-MD.A:** Calculate expected values and use them to solve problems. **HSS-MD.B**: Use probability to evaluate outcomes of decisions. **HSS-IC.A:** Understand and evaluate random processes underlying statistical experiments. **HSS-CP.A:** Understand independence and conditional probability and use them to interpret data. **HSS-CP.B:** Use the rules of probability to compute probabilities of compound events in a uniform probability model.	• CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #5: Use appropriate tools strategically. MP #7: Look for and make use of structure.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Probability is used to predict the likelihood that a random event will occur.	• How can an event be both random and predictable?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can find or estimate the probability using a model or data from a chance experiment. 2. I can create organized lists, tables, and tree diagrams to calculate probabilities.

How to use probability to predict the likelihood of the occurrence of real-world random events.	3. I can use information in a two-way table to find relative frequencies and to estimate probability. 4. I can calculate probabilities using the addition and multiplication rules. 5. I can use the fundamental counting principle, factorials, permutations, and combinations to determine the number of possible outcomes of an event. 6. I can calculate the expected value of an event. 7. I can use binomial distributions to calculate the probabilities of a binomial experiment. 8. I can use normal distributions and the central limit theorem to find probabilities with normally distributed data.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Assessment 1 1. I can find or estimate the probability using a model or data from a chance experiment. Test Questions: #1, 2, 3, 4, 5, 14, 24 2. I can create organized lists, tables, and tree diagrams to calculate probabilities. Test Questions: #13 3. I can use information in a two-way table to find relative frequencies and to estimate probability. Test Questions: #6 4. I can calculate probabilities by implementing the addition and multiplication rules. Test Questions: #8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 25 5. I can use the fundamental counting principle, factorials, permutations, and combinations to determine the number of possible outcomes of an event. Test Questions: #7, 19, 20, 21, 22, 23, 24, 26, 27 Unit 2 Assessment 2 6. I can calculate the expected value of an event. Test Questions: #1, 2, 6 7. I can use binomial distributions to calculate the probabilities of a binomial experiment. Test Questions: #3, 4, 5 8. I can use normal distributions and the central limit theorem to find probabilities with normally distributed data. Test Questions: #7, 8, 9, 10, 11	Pre- Assessment: Ongoing Assessments: Unit 2.1

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Classical and Empirical Probability</td><td>Estimated # of Lessons: 5</td></tr>
<tr><td>1. I can find or estimate the probability using a model or data from a chance experiment.
2. I can create organized lists, tables, and tree diagrams to calculate probabilities.
3. I can use information in a two-way table to find relative frequencies and to estimate probability.

4. I can calculate probabilities by implementing the addition and multiplication rules.

5. I can use the fundamental counting principle, factorials, permutations, and combinations to determine the number of possible outcomes of an event.</td><td>Essential Questions:

● How can an event be both random and predictable?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Given an experiment, write out the corresponding sample space.
2. Given an event, calculate the probability of the event occurring.
3. Given an event, calculate the probability of the complementary event occurring.
4. Given a compound event, which is or is not mutually exclusive, calculate the probability of the event occurring using the addition rule of probability.
5. Given a compound event, which is independent or dependent, calculate the probability of the event occurring using the multiplication rule of probability.
6. Given a real-world scenario, calculate the number of possible outcomes using the fundamental counting principle, factorials, permutations or combinations.</td></tr>
<tr><td colspan="2">Elementary Statistics 8th Edition, Allan G. Bluman</td></tr>
</table>

Second Unit Topic: Probability Distributions	Estimated # of Lessons: 4
Learning Target(s): 6. I can calculate the expected value of an event.	**Essential Questions:** ● How can an event be both random and predictable?

7. I can use binomial distributions to calculate the probabilities of a binomial experiment. 8. I can use normal distributions and the central limit theorem to find probabilities with normally distributed data.	

Learning Activities:

1. Given an event, construct the appropriate probability distribution.
2. Given a real-world situation, determine the expected value of the event occurring.
3. Given an experiment which fits the criteria to be classified as binomial find the probability of an event, within that experiment, occurring.
4. Given a real-world scenario where the data fits a normal distribution calculate the probability of an event occurring.

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<table>
<tr><td colspan="2">COURSE NAME: Precalculus   Unit 1: Preparing for Precalculus   Est. Time: 5 Weeks (6 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will build upon their previous math experience in performing mathematical operations with complex numbers, graphing, and solving quadratic functions, and representing sets of numbers. Students will use this review of foundational skills both to launch their precalculus journey and refer to it throughout the course.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CCSS Content Standards:
F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms or quantities, and sketch graphs showing key features given a verbal description of the relationship.
F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
F-IF.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions).
A-SSE.1b: Interpret complicated expression by viewing one or more of their parts as a single entity.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends.
● RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information.

MP #5: Use appropriate tools appropriately to solve problems.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Determining key features and representations of quadratic functions unlocks your capacity to read, manipulate, and/or solve the function.

● Functions can be represented in a variety of ways and can be used to model and solve real-world relationships.</td><td>● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?

● How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?</td></tr>
</table>

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to determine critical components and characteristics of quadratic functions. How to determine if simplified expression is equal to the original expression and can be used for comparison and problem solving.	1. (FOUNDATIONAL) I can represent a quadratic function using a graph, an equation, a table, or words. 2. I can calculate intercepts of quadratic functions by graphing, quadratic formula, completing the square, or factoring. 3. I can evaluate functions using an equation or graph. 4. I can identify symmetry in functions with respect to the origin, the y-axis, and the x-axis. 5. I can write the domain and range of a function using interval notation. 6. I can properly simplify expressions (real, complex, rational, irrational) using algebraic methods.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: Getting Ready for Precalculus Unit 1 Assessment 1. (FOUNDATIONAL) I can represent a quadratic function using a graph, an equation, a table, or words. Questions: #8, #13 2. I can calculate intercepts of quadratic functions by graphing, quadratic formula, completing the square, or factoring. Questions: # 2, #3, #4, #13 3. I can evaluate functions using an equation or graph. Questions: #7, #8, #12 4. I can identify symmetry in functions with respect to the origin, the y-axis, and the x-axis. Questions: #9 5. I can write the domain and range of a function using interval notation. Questions: #7, #11 6. I can properly simplify expressions (real, complex, rational, irrational) using algebraic methods. Questions: #1, #5, #6, #10	Ongoing Assessments: Unit 1 Quizzes Unit 1 Exit Tickets

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Function Fundamentals	**Estimated # of Lessons: 3**
Learning Target(s): 1. (FOUNDATIONAL) I can represent a quadratic function using a graph, an equation, a table, or words. 2. I can calculate intercepts of quadratic functions by graphing, quadratic formula, completing the square, or factoring. 3. I can evaluate functions using an equation or graph. 4. I can identify symmetry in functions with respect to the origin, the y-axis, and the x-axis. 5. I can write the domain and range of a function using interval notation.	**Essential Questions:** How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? How can I recognize function relationships in

	real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?
Learning Activities: 1. Solve quadratics using multiple methods (graphing, factoring, completing the square and Quadratic Formula). 2. Graphing various functions (quadratic, piecewise, linear, etc) while identifying key features. 3. Introduce appropriate technology to aid in solving or comparing equations. 4. Investigate algebraic and visual methods for showing symmetry in equations while looking for connections between the many methods.	
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Second Unit Topic: Foundations in Simplifying Expressions	**Estimated # of Lessons: 3**
Learning Target(s): 6. I can properly simplify expressions (real, complex, rational, irrational) using proper algebraic methods.	**Essential Questions:** ● How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?
Learning Activities: 1. Evaluate expressions that contain the four operations of complex numbers.	

2. Use laws of exponents to simplify rational expressions. 3. Practice alternating between radical and exponential form while looking at the benefits of each. 4. Simplify expressions with multiple operations and rational exponents to find a clear solution to solve a calculus-based problem.
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COURSE NAME: Precalculus **Unit 2: Functions from a Calculus Perspective** **Est. Time: 6 Weeks (5 lessons, class meets every other day)**	
OVERVIEW *In this unit, students will extend their algebra knowledge of functions to now explore symmetries of graphs, determine continuity and average rates of change of functions, and use limits to describe end behavior.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-BF.A**: Build a function that models a relationship between two quantities. **F-BF.B:** Find inverse functions	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. • CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #5: Use appropriate tools appropriately to solve problems.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Mathematical ideas can be represented verbally, algebraically, numerically, and graphically. Different representations each have their own advantages and disadvantages. • Using precise notation and language when describing a mathematical model allows for consistent communication.	• How can mathematical ideas be represented? • Why is it useful to use different representations for different contexts? • How can I use notation and language to clearly express my solution and reasoning?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to determine if a function is created by applying a series of transformations to a parent function or composing two functions together. How to use visual and algebraic methods for determining continuity and end behavior of functions.	I can identify a function as linear, quadratic, cubic, quartic, or exponential and based on that can perform the following skills: 1. I can use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing, or constant. 3. I can identify, graph, and describe parent functions and their transformations. 4. I can find compositions of functions. 5. I can find inverses of functions both algebraically and graphically.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Test: Functions from a Calculus Perspective Unit 2 Assessment.docx 1. I can use limits to determine continuity and end behavior of a function. Questions: #1, #5, #9 2. I can write intervals on which a function is increasing, decreasing of constant. Questions: #2, #3, #6 3. I can identify, graph and describe parent functions and their transformations. Questions: #6, #7, #8 4. I can find compositions of functions. Questions: #4, #5, #7 5. I can find the inverse of functions both algebraically and graphically. Question: #5	Ongoing Assessments: Unit 2 Quizzes Unit 2 Exit Tickets

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Calculus Based Function Analysis	**Estimated # of Lessons: 2**
Learning Target(s): 1. I can use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing of constant.	**Essential Questions:** • How can mathematical ideas be represented? • Why is it useful to use different representations for different contexts? • How can I use notation and language to clearly

	express my solution and reasoning?

Learning Activities:

1. Determine limits and intervals of increasing / decreasing from graphs.
2. Given limits and defined points, create an appropriate graph.
3. Integrate technology to identify extrema over a given interval.
4. Utilize a table of values to identify a limit of a given function.

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Second Unit Topic: Foundations in Function Development	**Estimated # of Lessons: 3**
Learning Target(s): 3. I can identify, graph, and describe parent functions and their transformations. 4. I can find compositions of functions. 5. I can find the inverse of functions both algebraically and graphically.	**Essential Questions:** • How can mathematical ideas be represented? Why is it useful to use different representations for different contexts?

Learning Activities:

1. Explore each transformation and the impact on a parent function using graphing technology.
2. Function composition practice $[f(g(x)),\ g(f(x)),\ f(f(x)),\ g(g(x))]$.
3. Graphical and algebraic practice of inverses.
4. Compositions of a series of inverse functions that simplify to *x*.
5. Apply learning to relevant SAT-based questions.

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COURSE NAME: Precalculus Unit 3: Power, Polynomial and Rational Functions Est. Time: 8 Weeks (6 lessons, class meets every other day)	
OVERVIEW *In this unit, students will extend their algebra knowledge of quadratic functions to now explore methods for discovering intercepts, determine continuity, use limits to describe end behavior, and commonalities between the three types of functions (power, polynomial and rational).*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-IF.C**: Graph functions expressed symbolically and show key features.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP#1 Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Mathematical ideas can be represented verbally, algebraically, numerically, and graphically and the appropriate representation is determined based on what you are trying to solve. • Using precise notation and language when describing a mathematical model allows for consistent communication.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • How can I use notation and language to clearly express my solution and reasoning?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to organize functions by leading coefficients and power to display similar characteristics. How to use arithmetic and algebraic methods for determining intercepts of functions and solving rational equations / inequalities.	I can identify a function as radical or polynomial, and based on that can perform the following skills: 1. I can write and use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing, or constant. 3. I can identify, graph, and describe the function using domain and range. 4. I can determine the intercepts of power, rational, and radical functions. 5. I can solve rational equations and inequalities.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 3 Test: Power, Polynomial and Rational Functions

1. I can write and use limits to determine continuity and end behavior of a function.
Questions: #1, #7, #9
2. I can write intervals on which a function is increasing, decreasing, or constant.
Questions: #1, #9
3. I can identify, graph, and describe the function using domain and range.
Questions: #1, #3, #7, #9
4. I can determine the intercepts of power, rational, and radical functions.
Questions: #1, #4, #7, #8, #9
5. I can solve rational equations and inequalities.
Questions: #2, #6</td><td>Ongoing Assessments:
Unit 3 Quizzes

Unit 3 Exit Tickets</td></tr>
<tr><td>● Performance Task: Students work collaboratively to represent a power function using a regression application on the graphing calculator and using the Essential Question: How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
● Transfer Skills: Communication, Critical Thinking.
● Understandings: #1, 2
● Learning Targets: #2, 3, 4, 5</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Graphing and analyzing power, radical, and polynomial functions.</td><td>Estimated # of Lessons: 2</td></tr>
<tr><td>Learning Target(s):

1. I can write and use limits to determine continuity and end behavior of a function.
2. I can write intervals on which a function is increasing, decreasing, or constant.
3. I can identify, graph, and describe the function using domain and range.</td><td>Essential Questions:

● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
● How can I use notation and language to clearly express my solution and reasoning?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Graphic organizers help show common characteristics of different functions.
2. Use Desmos to model different functions and compare / contrast features.
3. Graph real world data and use regression technology to determine corresponding function.</td></tr>
<tr><td colspan="2">https://connected.mcgraw-hill.com/connected/dashboard.do</td></tr>
</table>

<table>
<tr><th>Second Unit Topic: Determining Intercepts of Rational Functions</th><th>Estimated # of Lessons: 2</th></tr>
<tr><td>Learning Target(s):

4. I can determine the intercepts of power, rational, and radical functions.</td><td>Essential Questions:

● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Use long division and synthetic division to determine factors of polynomials.
2. Use the factor and remainder theorems to find correct factors.</td></tr>
</table>

3. Use the rational root theorem to determine possible factors and preserve to identify correct intercepts.
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Third Unit Topic: Rational and nonlinear functions	**Estimated # of Lessons: 3**
Learning Target(s): 4. I can determine the intercepts of power, rational, and radical functions. 5. I can solve rational equations and inequalities.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How can I use notation and language to clearly express my solution and reasoning?
Learning Activities: 1. Use Desmos to graph rational functions and analyze key features (intercepts and asymptotes.) 2. Graph rational functions without the help of technology by using intercepts and asymptotes as a guide and using a sign chart. 3. Determine the intervals for which the function is true, based on the inequality.	
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COURSE NAME: Precalculus	**Unit 4: Trigonometric Functions**	**Est. Time: 8 Weeks (7 lessons, class meets every other day)**

OVERVIEW

In this unit, students will learn about the relationship between the angles and sides of right and non-right triangles. Students will discover how to measure angles using degrees and radians. Students will then learn how to solve real world problems using properties of trigonometric functions and the unit circle.

STAGE 1 → IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	TRANSFER
CSDE Content Standards: **F-TF.A**: Extend the domain of trigonometric functions using the unit circle. **F-TF.B**: Model periodic phenomena with trigonometric functions: Understand that restricting a trigonometric function to a domain allows its inverse to be constructed. **F-BF.A**: Find inverse functions.	• CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP#1: Make sense of problems and persevere in solving them.

UNDERSTANDINGS	ESSENTIAL QUESTIONS
• The characteristics of trigonometric functions and their representations are useful in solving real-world problems. • Using precise notation and language when describing a mathematical model allows for consistent communication. • The unit circle provides a basis for solving trigonometric problems.	• How are graphs useful to help visualize and model relationships between real-world quantities? • How can I use notation and language to clearly express my solution and reasoning? • What relationship exists between a triangle and the unit circle?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to construct the model of a trigonometric function so that predictions can be made by evaluating the function. How can transformations be applied to trigonometric functions to increase periodicity, amplitude, midlines, and maximum & minimum points.	1. I can identify differences and similarities between degrees and radians. 2. I can graph all trigonometric functions (and transformations) using characteristics of a function. 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle. 4. I can use the Law of Sines and Law of Cosines to determine angles and side lengths of oblique triangles. 5. I can evaluate and graph inverse trigonometric functions.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 Test: Trigonometric Functions 1. I can identify differences and similarities between degrees and radians. Questions #1, #4, #5, #8, #9, #10 2. I can graph all trigonometric functions (and transformations) using characteristics of a function. Questions: #3, #5, #6, #7 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle. Questions: #1 4. I can use the Law of Sines and Law of Cosines to determine angles and side lengths of oblique triangles. Questions: #4, #8, #9, #10 5. I can evaluate and graph inverse trigonometric functions. Questions: #2	Ongoing Assessments: Unit 4 Quizzes Unit 4 Exit Tickets
• **Performance Task:** Students work independently to represent a unit circle creatively using the Essential Question: What relationship exists between a triangle and the unit circle? • Transfer Skills: Communication, Critical Thinking. • Understandings: #1, 2, 3 • Learning Targets: #1, 3	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Using right triangle trigonometry to model and solve real-world problems.	**Estimated # of Lessons: 3**
Learning Target(s): 1. I can identify differences and similarities between degrees and radians. 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle.	**Essential Questions:** ● How are graphs useful to help visualize and model relationships between real-world quantities? ● How can I use notation and language to clearly express my solution and reasoning? ● What relationship exists between a triangle and the unit circle?
Learning Activities: 1. Use pneumonic (SohCahToa) to model real-world situations using right triangles. 2. Understand and convert radians to degrees and visa-versa. 3. Develop a unit circle and understand the relationships between the hypotenuse and the ratios of the remaining sides of a right triangle. 4. Find values of trig functions using the unit circle.	
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Second Unit Topic: Graphing Trig Functions	**Estimated # of Lessons: 2**
Learning Target(s):	**Essential Questions:** ● How are graphs useful to help visualize and model relationships

1. I can identify differences and similarities between degrees and radians. 2. I can graph all trigonometric functions (and transformations) using characteristics of a function.	between real-world quantities? ● How can I use notation and language to clearly express my solution and reasoning? ● What relationship exists between a triangle and the unit circle?

Learning Activities:

1. Use Desmos (or graphing technology) to see key features in a trigonometric graph.
2. Use the unit circle to show how a trigonometric graph is developed.
3. Online resources are used to demonstrate the graph: geogebra.org, desmos.teacher.com
4. Student collaboration in groups to study trigonometric transformations.

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Third Unit Topic: Inverse Trig functions and Laws of Sines and Cosines	**Estimated # of Lessons: 3**
Learning Target(s): 2. I can graph all trigonometric functions (and transformations) using characteristics of a function. 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle. 4. I can use the Law of Sines and Law of Cosines to determine angles and side lengths of oblique triangles. 5. I can evaluate and graph inverse trigonometric functions.	**Essential Questions:** ● How are graphs useful to help visualize and model relationships between real-world quantities? ● How can I use notation and language to clearly express my solution and reasoning? ● What relationship exists between a triangle and the unit circle?

Learning Activities:

1. Determine the inverse of a trig function by restricting the domain of the original function.
2. Find compositions of trig functions through visual and mathematical methods.
3. Use the Law of Sines and Cosines to find areas and missing measurements of oblique triangles.
4. Solve real world problems using Laws of Sines and Cosines.

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COURSE NAME: Precalculus Unit 5: Trigonometric Identities and Equations Est. Time: 8 Weeks (5 lessons, class meets every other day)	
OVERVIEW *In this unit, students will extend their knowledge of trigonometric functions to now use trigonometric identities to transform expressions into forms that are more suitable for calculations in Calculus.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-TF.D**: Prove and apply trigonometric identities.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments and critique the reasoning of others. • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP#1: Make sense of problems and persevere in solving them. • RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP#2: Reason abstractly and quantitatively.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Leveraging the importance of multiple representations of trig identities in order to transform expressions that are more suitable for solving.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to rewrite, simplify and solve expressions and equations using trigonometric identities.	1. I can use trigonometric identities to rewrite expressions and equations. 2. I can solve problems using simplified and equivalent expressions.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 5 Test: Trigonometric Identities and Equations 1. I can use trigonometric identities to rewrite expressions and equations. Questions #1, #4, #5, #6, #7, #9 2. I can solve problems using simplified and equivalent expressions. Questions: #2, #3, #8, #9	Ongoing Assessments: Unit 5 Exit Tickets Unit 5 Quizzes
Unit 5 Performance Task • **Performance Task:** Students work collaboratively to represent trig expressions and solve trig equations in a game format using the Essential Question: How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? Transfer Skills: Communication, Critical Thinking, Research and Understanding • Understandings: #1 • Learning Targets: #1, 2	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Simplify expressions using trigonometric identities	**Estimated # of Lessons: 2**

Learning Target(s): 1. I can use trigonometric identities to rewrite expressions and equations.	**Essential Questions:** • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Real world problems that use trigonometric functions are given for students to simplify into usable expressions and equations. 2. Multiple practice sessions for students to work collaboratively and independently to rewrite trigonometric expressions using the identities.	
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Second Unit Topic: Solving equations using trig identities.	**Estimated # of Lessons: 3**
Learning Target(s): 2. I can solve problems using simplified and equivalent expressions.	**Essential Questions:** • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Identify and understand the myriad of trig identities that are available to rewrite and solve trig equations, both on an open and a closed interval. (Pythagorean, Inverse, Double-Angle, Half-Angle, Power Reducing, Product to Sum, Sum to Product) 2. Multiple practice sessions for students to work collaboratively and independently to solve trigonometric equations using the identities.	
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COURSE NAME: Precalculus Unit 6: Vectors Est. Time: 5 Weeks (3 lessons, class meets every other day)	
OVERVIEW *In this unit, students will pair their knowledge of trigonometry and angles with their understanding of distance formulas and Pythagorean Theorem to model and solve real-world scenarios involving magnitude and direction.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **N-VM.A**: Represent and model with vector quantities. **N-VM.B**: Perform operations on vectors.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments and critique the reasoning of others. • CRITICAL THINKING: Identify a problem, ask key questions, and make predictions MP#1: Make sense of problems and persevere in solving them. • RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information. MP#4: Model with mathematics
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Leveraging multiple representations of vectors, both direction and magnitude, in order to model real-world scenarios.	• How can you represent physical quantities that you cannot see in the real world?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can perform operations with vectors. 2. I can represent vectors in multiple ways.

How to use vectors to represent real-world scenarios.	3. I can use vectors to represent real-world scenarios.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 Test: Vectors 1. I can perform operations with vectors. Questions #3, #4, #7, #8, #9, #10 2. I can represent vectors in multiple ways. Questions: #1, #2, #4, #5, #6, #8, #10 3. I can use vectors to represent real-world scenarios. Questions: #5, #6	Ongoing Assessments: Unit 6 Exit Tickets Unit 6 Quizzes
• **Performance Task:** Students work collaboratively or independently to create a vector map and presentation of a trip around the earth using the Essential Question: How can you represent physical quantities that you cannot see in the real world? Transfer Skills: Communication, Critical Thinking, Research and Understanding • Understandings: #1 • Learning Targets: #2, 3	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Model with Vectors	**Estimated # of Lessons: 3**

Learning Target(s):	**Essential Questions:**
1. I can perform operations with vectors. 2. I can represent vectors in multiple ways. 3. I can use vectors to represent real-world scenarios.	• How can you represent physical quantities that you cannot see in the real world?

Learning Activities:

1. Represent and operate with vectors geometrically to determine a resultant vector.
2. Use Desmos technology to practice finding magnitude (I.e., speed, force, distance, etc.) and direction in real world situations (football, river current, wind effects on aircraft.)
3. Represent and operate with vectors in the coordinate plane.
4. Determine the dot product of two vectors and use the dot product to find the angle between them.

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COURSE NAME: Precalculus Unit 1: Preparing for Precalculus **Est. Time: 4 Weeks (6 Lessons, class meets every other day)**	
OVERVIEW *In this unit, students will build upon their previous math experience in performing mathematical operations with complex numbers, graphing, and solving quadratic functions, and representing sets of numbers. Students will use this review of foundational skills both to launch their precalculus journey and to refer to it throughout the course.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-IF.4**: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms or quantities, and sketch graphs showing key features given a verbal description of the relationship. **F-IF.5**: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. **F-IF.9:** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions). **A-SSE.1b:** Interpret complicated expression by viewing one or more of their parts as a single entity.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. • RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information. MP #5: Use appropriate tools appropriately to solve problems.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Determining key features and representations of quadratic functions unlocks your capacity to read, manipulate, and/or solve the function. • Functions can be represented in a variety of ways and can be used to model and solve real-world relationships.	• How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? • How can I recognize function relationships in real-world contexts and represent them mathematically? How do these functions help us analyze different scenarios?

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to determine critical components and characteristics of quadratic functions. How to determine if simplified expression is equal to the original expression and can be used for comparison and problem solving.	1. (FOUNDATIONAL) I can represent a quadratic function using a graph, an equation, a table, or words. 2. I can calculate intercepts of quadratic functions by graphing, quadratic formula, completing the square, or factoring. 3. I can evaluate functions using an equation or graph. 4. I can identify symmetry in functions with respect to the origin, the y-axis, and the x-axis. 5. I can write the domain and range of a function using interval notation. 6. I can properly simplify expressions (real, complex, rational, irrational) using algebraic methods.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: Getting Ready for Precalculus Unit 1 Assessment 1. (FOUNDATIONAL) I can represent a quadratic function using a graph, an equation, a table, or words. Questions: #8, #13 2. I can calculate intercepts of quadratic functions by graphing, quadratic formula, completing the square, or factoring. Questions: # 2, #3, #4, #13 3. I can evaluate functions using an equation or graph. Questions: #7, #8, #12 4. I can identify symmetry in functions with respect to the origin, the y-axis, and the x-axis. Questions: #9 5. I can write the domain and range of a function using interval notation. Questions: #7, #11 6. I can properly simplify expressions (real, complex, rational, irrational) using algebraic methods. Questions: #1, #5, #6, #10	Pre- Assessment: Ongoing Assessments: Unit Quizzes Practice Problem Sets

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Function Fundamentals	**Estimated # of Lessons: 3**
Learning Target(s): 1. (FOUNDATIONAL) I can represent a quadratic function using a graph, an equation, a table, or words. 2. I can calculate intercepts of quadratic functions by graphing, quadratic formula, completing the square, or factoring. 3. I can evaluate functions using an equation or graph. 4. I can identify symmetry in functions with respect to the origin, the y-axis, and the x-axis. 5. I can write the domain and range of a function using interval notation.	**Essential Questions:** How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with? How can I recognize function relationships in real-world contexts and

	represent them mathematically? How do these functions help us analyze different scenarios?

Learning Activities:

1. Solve quadratics using multiple methods (graphing, factoring, completing the square and Quadratic Formula).
2. Graphing various functions (quadratic, piecewise, linear, etc) while identifying key features.
3. Introduce appropriate technology to aid in solving or comparing equations.
4. Investigate algebraic and visual methods for showing symmetry in equations while looking for connections between the many methods.

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Second Unit Topic: Foundations in Simplifying Expressions	**Estimated # of Lessons: 3**
Learning Target(s): 6. I can properly simplify expressions (real, complex, rational, irrational) using proper algebraic methods.	**Essential Questions:** • How does the equation of a function provide us information about the relationship between its inputs and outputs? How are new functions connected to functions I am already familiar with?

Learning Activities:

1. Evaluate expressions that contain the four operations of complex numbers.
2. Use laws of exponents to simplify rational expressions.

3. Practice alternating between radical and exponential form while looking at the benefits of each. 4. Simplify expressions with multiple operations and rational exponents to find a clear solution to solve a calculus-based problem.
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COURSE NAME: Precalculus **Unit 2: Functions from a Calculus Perspective** **Est. Time: 5 Weeks (5 lessons, class meets every other day)**	
OVERVIEW *In this unit, students will extend their algebra knowledge of functions to now explore symmetries of graphs, determine continuity and average rates of change of functions, and use limits to describe end behavior.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-BF.A**: Build a function that models a relationship between two quantities. **F-BF.B:** Find inverse functions	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. • CRITICAL THINKING: Identify a problem, ask key questions, and make predictions. MP #5: Use appropriate tools appropriately to solve problems.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Mathematical ideas can be represented verbally, algebraically, numerically, and graphically. Different representations each have their own advantages and disadvantages. • Using precise notation and language when describing a mathematical model allows for consistent communication.	• How can mathematical ideas be represented? • Why is it useful to use different representations for different contexts? • How can I use notation and language to clearly express my solution and reasoning?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to determine if a function is created by applying a series of transformations to a parent function or composing two functions together. How to use visual and algebraic methods for determining continuity and end behavior of functions.	I can identify a function as linear, quadratic, cubic, quartic, or exponential and based on that can perform the following skills: 1. I can use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing, or constant. 3. I can identify, graph, and describe parent functions and their transformations. 4. I can find compositions of functions. 5. I can find inverses of functions both algebraically and graphically.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Test: Functions from a Calculus Perspective Unit 2 Assessment 1. I can use limits to determine continuity and end behavior of a function. Questions: #1, #5, #9 2. I can write intervals on which a function is increasing, decreasing of constant. Questions: #2, #3, #6 3. I can identify, graph and describe parent functions and their transformations. Questions: #6, #7, #8 4. I can find compositions of functions. Questions: #4, #5, #7 5. I can find the inverse of functions both algebraically and graphically. Question: #5	Pre- Assessment: Unit 2 Pre-Assessment Ongoing Assessments: Curated Problem Sets Unit 2 Quizzes
• **Performance Task:** Students work collaboratively to represent a parent function both visually and mathematically along with key characteristics using the Essential Question: How are mathematical ideas represented? Why is it useful to use different representations for different contexts? • Transfer Skills: Communication, Critical Thinking • Understandings: #1, 2 • Learning Targets: #1, 2, 3	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Calculus Based Function Analysis	**Estimated # of Lessons: 2**
Learning Target(s): 1. I can use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing of constant.	**Essential Questions:** ● How can mathematical ideas be represented? ● Why is it useful to use different representations for different contexts? ● How can I use notation and language to clearly express my solution and reasoning?
Learning Activities: 1. Determine limits and intervals of increasing / decreasing from graphs. 2. Given limits and defined points, create an appropriate graph. 3. Integrate technology to identify extrema over a given interval. 4. Utilize a table of values to identify a limit of a given function.	
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Second Unit Topic: Foundations in Function Development	**Estimated # of Lessons: 3**
Learning Target(s): 3. I can identify, graph, and describe parent functions and their transformations. 4. I can find compositions of functions. 5. I can find the inverse of functions both algebraically and graphically.	**Essential Questions:** ● How can mathematical ideas be represented? Why is it useful to use different representations for different contexts?

Learning Activities: 1. Explore each transformation and the impact on a parent function using graphing technology. 2. Function composition practice $[f(g(x)),\ g(f(x)),\ f(f(x)),\ g(g(x))]$. 3. Graphical and algebraic practice of inverses. 4. Compositions of a series of inverse functions that simplify to *x*. 5. Apply learning to relevant SAT-based questions.
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COURSE NAME: Precalculus Unit 3: Power, Polynomial and Rational Functions Est. Time: 10 Weeks (6 lessons, class meets every other day)	
OVERVIEW *In this unit, students will extend their algebra knowledge of quadratic functions to now explore methods for discovering intercepts, determine continuity, use limits to describe end behavior, and commonalities between the three types of functions (power, polynomial and rational).*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-IF.C**: Graph functions expressed symbolically and show key features.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP#1 Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Mathematical ideas can be represented verbally, algebraically, numerically, and graphically and the appropriate representation is determined based on what you are trying to solve. ● Using precise notation and language when describing a mathematical model allows for consistent communication.	● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How can I use notation and language to clearly express my solution and reasoning?

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to organize functions by leading coefficients and power to display similar characteristics. How to use arithmetic and algebraic methods for determining intercepts of functions and solving rational equations / inequalities.	I can identify a function as radical or polynomial, and based on that can perform the following skills: 1. I can write and use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing, or constant. 3. I can identify, graph, and describe the function using domain and range. 4. I can determine the intercepts of power, rational, and radical functions. 5. I can solve rational equations and inequalities.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 3 Test: Power, Polynomial and Rational Functions
Unit 3 Test
1. I can write and use limits to determine continuity and end behavior of a function.
Questions: #1, #7, #9
2. I can write intervals on which a function is increasing, decreasing, or constant.
Questions: #1, #9
3. I can identify, graph, and describe the function using domain and range.
Questions: #1, #3, #7, #9
4. I can determine the intercepts of power, rational, and radical functions.
Questions: #1, #4, #7, #8, #9
5. I can solve rational equations and inequalities.
Questions: #2, #6</td><td>Unit 3 Pre-Assessment

Ongoing Assessments: Curated Problem Sets

Unit 3 Quizzes</td></tr>
<tr><td>• Performance Task: Students work collaboratively to represent a power function using a regression application on the graphing calculator and using the Essential Question: How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
• Transfer Skills: Communication, Critical Thinking.
• Understandings: #1, 2
• Learning Targets: #2, 3, 4, 5</td><td></td></tr>
</table>

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Graphing and analyzing power, radical, and polynomial functions.	**Estimated # of Lessons: 2**
Learning Target(s): 1. I can write and use limits to determine continuity and end behavior of a function. 2. I can write intervals on which a function is increasing, decreasing, or constant. 3. I can identify, graph, and describe the function using domain and range.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How can I use notation and language to clearly express my solution and reasoning?
Learning Activities: 1. Graphic organizers help show common characteristics of different functions. 2. Use Desmos to model different functions and compare / contrast features. 3. Graph real world data and use regression technology to determine corresponding function.	
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Second Unit Topic: Determining Intercepts of Rational Functions	Estimated # of Lessons: 2
Learning Target(s): 4. I can determine the intercepts of power, rational, and radical functions.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Use long division and synthetic division to determine factors of polynomials. 2. Use the factor and remainder theorems to find correct factors.	

3. Use the rational root theorem to determine possible factors and preserve to identify correct intercepts.
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Third Unit Topic: Rational and nonlinear functions	**Estimated # of Lessons: 3**
Learning Target(s): 4. I can determine the intercepts of power, rational, and radical functions. 5. I can solve rational equations and inequalities.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How can I use notation and language to clearly express my solution and reasoning?
Learning Activities: 1. Use Desmos to graph rational functions and analyze key features (intercepts and asymptotes.) 2. Graph rational functions without the help of technology by using intercepts and asymptotes as a guide and using a sign chart. 3. Determine the intervals for which the function is true, based on the inequality.	
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<table>
<tr><td colspan="2">COURSE NAME: Precalculus Unit 4: Trigonometric Functions Est. Time: 10 Weeks (7 lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will learn about the relationship between the angles and sides of right and non-right triangles. Students will discover how to measure angles using degrees and radians. Students will then learn how to solve real world problems using properties of trigonometric functions and the unit circle.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
F-TF.A: Extend the domain of trigonometric functions using the unit circle.
F-TF.B: Model periodic phenomena with trigonometric functions: Understand that restricting a trigonometric function to a domain allows its inverse to be constructed.
F-BF.A: Find inverse functions.</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP#1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● The characteristics of trigonometric functions and their representations are useful in solving real-world problems.

● Using precise notation and language when describing a mathematical model allows for consistent communication.

● The unit circle provides a basis for solving trigonometric problems.</td><td>● How are graphs useful to help visualize and model relationships between real-world quantities?

● How can I use notation and language to clearly express my solution and reasoning?

● What relationship exists between a triangle and the unit circle?</td></tr>
</table>

KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to construct the model of a trigonometric function so that predictions can be made by evaluating the function. How can transformations be applied to trigonometric functions to increase periodicity, amplitude, midlines, and maximum & minimum points.	1. I can identify differences and similarities between degrees and radians. 2. I can graph all trigonometric functions (and transformations) using characteristics of a function. 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle. 4. I can use the Law of Sines and Law of Cosines to determine angles and side lengths of oblique triangles. 5. I can evaluate and graph inverse trigonometric functions.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 Test: Trigonometric Functions Unit 4 Test 1. I can identify differences and similarities between degrees and radians. Questions #1, #4, #5, #8, #9, #10 2. I can graph all trigonometric functions (and transformations) using characteristics of a function. Questions: #3, #5, #6, #7 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle. Questions: #1 4. I can use the Law of Sines and Law of Cosines to determine angles and side lengths of oblique triangles. Questions: #4, #8, #9, #10 5. I can evaluate and graph inverse trigonometric functions. Questions: #2	Unit 4 Pre-Assessment Ongoing Assessments: Curated Problem Sets Unit 4 Quizzes
• **Performance Task:** Students work independently to represent a unit circle creatively using the Essential Question: What relationship exists between a triangle and the unit circle? • Transfer Skills: Communication, Critical Thinking. • Understandings: #1, 2, 3 • Learning Targets: #1, 3	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Using right triangle trigonometry to model and solve real-world problems.	**Estimated # of Lessons: 3**
Learning Target(s): 1. I can identify differences and similarities between degrees and radians. 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle.	**Essential Questions:** ● How are graphs useful to help visualize and model relationships between real-world quantities? ● How can I use notation and language to clearly express my solution and reasoning? ● What relationship exists between a triangle and the unit circle?
Learning Activities: 1. Use pneumonic (SohCahToa) to model real-world situations using right triangles. 2. Understand and convert radians to degrees and visa-versa. 3. Develop a unit circle and understand the relationships between the hypotenuse and the ratios of the remaining sides of a right triangle. 4. Find values of trig functions using the unit circle.	
https://connected.mcgraw-hill.com/connected/dashboard.do	

Second Unit Topic: Graphing Trig Functions	**Estimated # of Lessons: 2**
Learning Target(s):	**Essential Questions:** ● How are graphs useful to help visualize and model relationships

1. I can identify differences and similarities between degrees and radians. 2. I can graph all trigonometric functions (and transformations) using characteristics of a function.	between real-world quantities? • How can I use notation and language to clearly express my solution and reasoning? • What relationship exists between a triangle and the unit circle?
Learning Activities: 1. Use Desmos (or graphing technology) to see key features in a trigonometric graph. 2. Use the unit circle to show how a trigonometric graph is developed. 3. Online resources are used to demonstrate the graph: geogebra.org, desmos.teacher.com 4. Student collaboration in groups to study trigonometric transformations.	
https://connected.mcgraw-hill.com/connected/dashboard.do	

Third Unit Topic: Inverse Trig functions and Laws of Sines and Cosines	**Estimated # of Lessons: 3**
Learning Target(s): 2. I can graph all trigonometric functions (and transformations) using characteristics of a function. 3. I can evaluate/solve trigonometric functions aided by pneumonic and/or the unit circle. 4. I can use the Law of Sines and Law of Cosines to determine angles and side lengths of oblique triangles. 5. I can evaluate and graph inverse trigonometric functions.	**Essential Questions:** • How are graphs useful to help visualize and model relationships between real-world quantities? • How can I use notation and language to clearly express my solution and reasoning? • What relationship exists between a triangle and the unit circle?

Learning Activities:

1. Determine the inverse of a trig function by restricting the domain of the original function.
2. Find compositions of trig functions through visual and mathematical methods.
3. Use the Law of Sines and Cosines to find areas and missing measurements of oblique triangles.
4. Solve real world problems using Laws of Sines and Cosines.

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COURSE NAME: Precalculus Unit 5: Trigonometric Identities and Equations Est. Time: 6 Weeks (5 lessons, class meets every other day)	
OVERVIEW *In this unit, students will extend their knowledge of trigonometric functions to now use trigonometric identities to transform expressions into forms that are more suitable for calculations in Calculus.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **F-TF.D**: Prove and apply trigonometric identities.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments and critique the reasoning of others. • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP#1: Make sense of problems and persevere in solving them. • RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP#2: Reason abstractly and quantitatively.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Leveraging the importance of multiple representations of trig identities in order to transform expressions that are more suitable for solving.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to rewrite, simplify and solve expressions and equations using trigonometric identities.	1. I can use trigonometric identities to rewrite expressions and equations. 2. I can solve problems using simplified and equivalent expressions.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 5 Test: Trigonometric Identities and Equations Unit 5 Test 1. I can use trigonometric identities to rewrite expressions and equations. Questions #1, #4, #5, #6, #7, #9 2. I can solve problems using simplified and equivalent expressions. Questions: #2, #3, #8, #9	Unit 5 Pre-Assessment Ongoing Assessments: Curated Problem Sets Unit 5 Quizzes
• **Performance Task:** Students work collaboratively to represent trig expressions and solve trig equations in a game format using the Essential Question: How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? Transfer Skills: Communication, Critical Thinking, Research and Understanding • Understandings: #1 • Learning Targets: #1, 2 Unit 5 Performance Task	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Simplify expressions using trigonometric identities	**Estimated # of Lessons: 2**

<table>
<tr><td>Learning Target(s):
1. I can use trigonometric identities to rewrite expressions and equations.</td><td>Essential Questions:
• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Real world problems that use trigonometric functions are given for students to simplify into usable expressions and equations.
2. Multiple practice sessions for students to work collaboratively and independently to rewrite trigonometric expressions using the identities.</td></tr>
<tr><td colspan="2">https://connected.mcgraw-hill.com/connected/dashboard.do</td></tr>
</table>

<table>
<tr><td>Second Unit Topic: Solving equations using trig identities.</td><td>Estimated # of Lessons: 3</td></tr>
<tr><td>Learning Target(s):
2. I can solve problems using simplified and equivalent expressions.</td><td>Essential Questions:
• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Identify and understand the myriad of trig identities that are available to rewrite and solve trig equations, both on an open and a closed interval. (Pythagorean, Inverse, Double-Angle, Half-Angle, Power Reducing, Product to Sum, Sum to Product)
2. Multiple practice sessions for students to work collaboratively and independently to solve trigonometric equations using the identities.</td></tr>
<tr><td colspan="2">https://connected.mcgraw-hill.com/connected/dashboard.do</td></tr>
</table>

COURSE NAME: Precalculus Unit 6: Vectors Est. Time: 5 Weeks (3 lessons, class meets every other day)	
OVERVIEW *In this unit, students will pair their knowledge of trigonometry and angles with their understanding of distance formulas and Pythagorean Theorem to model and solve real-world scenarios involving magnitude and direction.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: **N-VM.A**: Represent and model with vector quantities. **N-VM.B**: Perform operations on vectors.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Construct viable arguments and critique the reasoning of others. • CRITICAL THINKING: Identify a problem, ask key questions, and make predictions MP#1: Make sense of problems and persevere in solving them. • RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information. MP#4: Model with mathematics
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Leveraging multiple representations of vectors, both direction and magnitude, in order to model real-world scenarios.	• How can you represent physical quantities that you cannot see in the real world?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use vectors to represent real-world scenarios.	1. I can perform operations with vectors. 2. I can represent vectors in multiple ways. 3. I can use vectors to represent real-world scenarios.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 Test: Vectors Unit 6 Test 1. I can perform operations with vectors. Questions #3, #4, #7, #8, #9, #10 2. I can represent vectors in multiple ways. Questions: #1, #2, #4, #5, #6, #8, #10 3. I can use vectors to represent real-world scenarios. Questions: #5, #6	Unit 6 Pre-Assessment Ongoing Assessments: Curated Problem Sets Unit 6 Quizzes
• **Performance Task:** Students work collaboratively or independently to create a vector map and presentation of a trip around the earth using the Essential Question: How can you represent physical quantities that you cannot see in the real world? Transfer Skills: Communication, Critical Thinking, Research and Understanding • Understandings: #1 • Learning Targets: #2, 3	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION

<table>
<tr><td>First Unit Topic: Model with Vectors</td><td>Estimated # of Lessons: 3</td></tr>
<tr><td>Learning Target(s):

1. I can perform operations with vectors.
2. I can represent vectors in multiple ways.
3. I can use vectors to represent real-world scenarios.</td><td>Essential Questions:

• How can you represent physical quantities that you cannot see in the real world?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Represent and operate with vectors geometrically to determine a resultant vector.
2. Use Desmos technology to practice finding magnitude (I.e., speed, force, distance, etc.) and direction in real world situations (football, river current, wind effects on aircraft.)
3. Represent and operate with vectors in the coordinate plane.
4. Determine the dot product of two vectors and use the dot product to find the angle between them.</td></tr>
<tr><td colspan="2">https://connected.mcgraw-hill.com/connected/dashboard.do</td></tr>
</table>

COURSE NAME: Calculus Unit Title: Limits and Continuity Est. Time: 8 Weeks (12 lessons, meets every other day)	
OVERVIEW In this unit, students will continue to work with limits. Limits introduce the subtle distinction between evaluating a function at a point and considering what value the function is approaching, if any, as x approaches a point. This distinction allows us to extend understanding of asymptotes and holes in graphs with formal definitions of continuity.	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Calculus uses limits to understand and model dynamic change. ● Limits can be found graphically, numerically, and analytically and selecting the appropriate strategy allows for more efficient problem solving.	● Can change occur at an instant? ● How do we use limits to extend concepts from Algebra? ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
The limit of a function is the value that the function becomes arbitrarily close to as its input becomes sufficiently close to some real number.	1. I can estimate the value of a limit from a graphical or tabular representation. 2. I can determine the precise value of a limit using algebraic manipulation. 3. I can determine the continuity of a function using limits. 4. I can apply the squeeze theorem to evaluate a limit. 5. I can determine if a limit will exist. 6. I can select and apply an appropriate strategy for evaluating a limit. 7. I can use limits to analyze the asymptotes and end behavior of a function.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test - Limits 1. I can estimate the value of a limit from a graphical or tabular representation. Test Question: #4, #16 2. I can determine the precise value of a limit using algebraic manipulation. Test Question: #1, #6, #7, #8, #9, #15 3. I can determine the continuity of a function using limits. Test Question: #2, #3, #5, #14 4. I can apply the squeeze theorem to evaluate a limit. Test Question: #12 5. I can determine if a limit will exist. Test Question: #4, #10 6. I can select an appropriate strategy for evaluating a limit. Test Question: #7, #8, #10, #11, #12 7. I can use limits to analyze the asymptotes and end behavior of a function. Test Question: #4, #10, #11, #13	Ongoing Assessment: Pre-Calculus Review Assessment Quizzes Curated Practice Problem Sets
STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	

First Unit Topic: Basic Strategies for Evaluating Limits	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can estimate the value of a limit from a graphical or tabular representation. 2. I can determine the precise value of a limit using algebraic manipulation. 3. I can determine the continuity of a function using limits. 5. I can determine if a limit will exist.	**Essential Questions:** ● Can change occur at an instant? ● How do we use limits to extend concepts from Algebra? ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Refresh on the concept of a limit in the new context of rate of change. 2. Review estimating limits graphically through student-led problem solving. 3. Analyze the graphs of rational functions to begin evaluating limits analytically.	

4. Define continuity in terms of limits and use this to analyze continuity analytically (rather than using a graph or table).
CollegeBoard AP Calculus AB Course and Exam Description

<table>
<tr><th>Second Unit Topic: Other Strategies for Evaluating Limits</th><th>Estimated # of Lessons: 6</th></tr>
<tr><td>Learning Target(s):
4. I can apply the squeeze theorem to evaluate a limit.
5. I can determine if a limit will exist.
6. I can select and apply an appropriate strategy for evaluating a limit.
7. I can use limits to analyze the asymptotes and end behavior of a function.</td><td>Essential Questions:
● How do we use limits to extend concepts from Algebra?
● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td colspan="2">Learning Activities:
1. Introduce the squeeze theorem through geometric examples, then look at algebraic problems where it can be applied.
2. Using functions with familiar options available for algebraic manipulation, introduce other strategies for evaluating limits analytically.
3. Graphically explore how limits connect to asymptotes and end behavior of functions. Specifically discuss the existence (or non-existence) of limits at these graphical features.</td></tr>
<tr><td colspan="2">CollegeBoard AP Calculus AB Course and Exam Description</td></tr>
</table>

COURSE NAME: Calculus Unit Title: Differentiation Est. Time: 8 Weeks (12 lessons, meets every other day)	
OVERVIEW In this unit students will develop methods to calculate instantaneous rate of change. Students first learn the limit definition of derivatives then develop shortcut methods to differentiate different types of functions. Then students learn how to differentiate composite functions using the chain rule and apply that understanding to determine derivatives of implicit and inverse functions	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	• CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Calculus uses limits to understand and model dynamic change. • Derivatives can be found with limits using the slope equation or by different derivative rules. The appropriate strategy allows for more efficient problem solving. • The chain rule can be used to differentiate implicit equations to find rate the rate of change of different relations.	• Can change occur at an instant? • How do we use limits to extend concepts from Algebra? • How can we find rate of change of equations with two variables?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
The rate of change at an instant can be evaluated by finding the rate of change over an interval that is infinitesimally small using limits and algebraic manipulation. Using algebra, we can derive shortcut methods to differentiating different classes functions. The chain rule allows us to differentiate composite functions and implicit relations.	1. I can estimate the rate of change from a graphical or tabular representation. 2. I can determine the precise value of the rate of changed of a relation at a point using algebraic manipulation. 3. I can write the equations of tangent lines and locate at which point the derivative is a specific value 4. I can determine when derivatives do and do not exist. 5. I can apply the power rule, product rule, quotient rule, and chain rule.

	6. I can apply derivatives to transcendental functions 7. I can select an appropriate strategy for differentiating relations. 8. I can differentiate implicit equations. 9. I can differentiate inverse functions 10. I can find higher-order derivatives

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Calculus Test 1. I can estimate the rate of change from a graphical or tabular representation. Test Question: #7 2. I can determine the precise value of the rate of changed of a relation at a point Test Question: #8 3. I can write the equations of tangent lines and locate at which point the derivative is a specific value Test Question: #1 4. I can determine when derivatives do and do not exist. Test Question: #9 5. I can apply the power rule, product rule, quotient rule, and chain rule. Test Question: #3 6. I can apply derivatives to transcendental functions Test Question: #6 7. I can select an appropriate strategy for differentiating relations. Test Question: #1, #2 8. I can differentiate implicit equations. Test Question: #2 9. I can differentiate inverse functions Test Question: #5 10. I can find higher-order derivatives Test Question: #4	Quizzes Curated Practice Problem Sets
STAGE 3 □ LEARNING PLAN EXPERIENCES AND INSTRUCTION	

First Unit Topic: Rate of Change at an Instant	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can estimate the rate of change from a graphical or tabular representation. 2. I can determine the precise value of the rate of changed of a relation at a point using algebraic manipulation. 3. I can write the equations of tangent lines and locate at which point the derivative is a specific value 4. I can determine when derivatives do and do not exist.	**Essential Questions:** ● Can change occur at an instant? ● How do we use limits to extend concepts from Algebra?

5. I can apply the power rule, product rule, quotient rule, and chain rule. 6. I can apply derivatives to transcendental functions.	
Learning Activities: 1. Refresh on the concept of a limit in the new context of rate of change. 2. Develop and apply general derivative rules for different categories of functions. 3. Analyze graphs to approximate rate of change and identify differentiability.	
CollegeBoard AP Calculus AB Course and Exam Description	

Second Unit Topic: Strategies for Differentiation	**Estimated # of Lessons: 6**
Learning Target(s): 7. I can select an appropriate strategy for differentiating relations. 8. I can differentiate implicit equations. 9. I can differentiate inverse functions. 10. I can find higher-order derivatives.	**Essential Questions:** ● How do we use limits to extend concepts from Algebra? ● How can we find rate of change of equations with two variables?
Learning Activities: 1. Develop and apply derivative rules for transcendental and inverse functions. 2. Develop and apply methods for differentiating implicit relations. 3. Apply derivative rules given the graph of a function. 4. Apply derivative rules to find higher-order derivatives.	
CollegeBoard AP Calculus AB Course and Exam Description	

COURSE NAME: Calculus Unit Title: Applications of Differentiation Est. Time: 8 Weeks (13 lessons, meets every other day)	
OVERVIEW In this unit students begin by developing understanding of average and instantaneous rates of change in problems involving motion. The unit then identifies differentiation as a common underlying structure on which to build understanding of change in a variety of contexts. Students' understanding of units of measure often reinforces their understanding of contextual applications of differentiation. In problems involving related rates, identifying the independent variable common to related functions may help students to correctly apply the chain rule. When applying differentiation to determine limits of certain indeterminate forms using L'Hospital's rule, students must show that the rule applies. Then the superficial details of contextual applications of differentiation are stripped away to focus on abstract structures and formal conclusions. Reasoning with definitions and theorems establishes that answers and conclusions are more than conjectures; they have been analytically determined. As when students showed supporting work for answers in previous units, students will learn to present justifications for their conclusions about the behavior of functions over certain intervals or the locations of extreme values or points of inflection. The unit concludes this study of differentiation by applying abstract reasoning skills to justify solutions for realistic optimization problems.	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	• RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision. • CRITICAL THINKING: Demonstrate flexibility and determination when problem solving. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Calculus uses limits to understand and model dynamic change. • Differentiation is a common underlying structure applied in common real-world situations that change over time • Use strict definitions and theorems to draw conclusions about a given function	• Can change occur at an instant? • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • How can we connect functional representations to graphical representations?

KNOWLEDGE	SKILLS (framed as Learning Targets)
• Given a function and what we know about the first and second derivative we can find key features of a graph. • Given situation with multiple variables students can find relationships between them to solve real-world problems.	1. I can find intervals of increasing/ decreasing, critical points and relative extrema analytically and graphically. 2. I can find intervals of concavity and points of inflection analytically and graphically. 3. I can solve problems involving linear particle motion. 4. I can sketch graphs of functions and derivatives given graphs of the derivatives or functions respectively. 5. I can apply the mean value theorem to solve problems. 6. I can apply rate of change to real world problems (related rates/ optimization)

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 3 Test

1. I can find intervals of increasing/ decreasing, critical points and relative extrema analytically and graphically.

Test Question: #1, #4, #5, #6, #7, #9, #11, #15
2. I can find intervals of concavity and points of inflection analytically and graphically.

Test Question: #1, #7, #9, #10, 14
3. I can solve problems involving linear particle motion.

Test Question: #2
4. I can sketch graphs of functions and derivatives given graphs of the derivatives or functions respectively.

Test Question: #3, #9, 14
5. I can apply the mean value theorem to solve problems.

Test Question: #8
6. I can apply rate of change to real world problems (related rates/ optimization)
Test Question: #12, #13, #16, #17</td><td>Quizzes

Curated Practice Problem Sets</td></tr>
<tr><td>STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION</td><td></td></tr>
<tr><td>● Performance Task: Students find a simple three-dimensional container, find the dimensions and the optimal dimensions using calculus. Then, if the containers dimensions are not optimal (can hold the most volume using the least material) students must come up with reasons why a particular company does not use these efficient dimensions. Finally, students must present and defend their findings to the class.
● Transfer Skills: Synthesize information to solve problems and defend claims.
● Understandings: #2
● Learning Targets: #1, #6</td><td></td></tr>
</table>

First Unit Topic: Contextual Applications of Derivatives	Estimated # of Lessons: 6
Learning Target(s): 3. I can solve problems involving linear particle motion.	**Essential Questions:** ● Can change occur at an instant? ● How can representing the same mathematical relationship in different

6. I can apply rate of change to real world problems (related rates)	ways allow us to model real-world scenarios and solve problems?
Learning Activities: ● Use relationships to develop and apply methods for solving problems involving how quantities change over time.	
CollegeBoard AP Calculus AB Course and Exam Description	

Second Unit Topic: Analytic Applications of Derivatives	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can find intervals of increasing/ decreasing, critical points and relative extrema analytically and graphically. 2. I can find intervals of concavity and points of inflection analytically and graphically. 4. I can sketch graphs of functions and derivatives given graphs of the derivatives or functions respectively. 5. I can apply the mean value theorem to solve problems. 6. I can apply rate of change to real world problems (optimization)	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How can we connect functional representations to graphical representations?
Learning Activities: 1. Define intervals of increasing and decreasing, critical points, and relative extrema. 2. Use previous definitions, theorems and tests to find intervals if increasing and decreasing and relative extrema analytically and graphically. 3. Define concavity and points of inflection and use the definitions to solve problems. 4. Curve sketching 5. Find optimal quantities for given real-world problems.	
CollegeBoard AP Calculus AB Course and Exam Description	

COURSE NAME: Calculus Unit Title: Integration Est. Time: 8 Weeks (13 lessons, meets every other day)	
OVERVIEW In this unit, students are initially introduced to the anti-derivative and the definite integral as two separate concepts for undoing a derivative and finding a sum, respectively. As they move through the unit, they see, through shared notation and through application problems, that the two concepts are connected. Eventually, students begin using the Fundamental Theorem of Calculus to find definite integrals using anti-derivatives. As they progress through the unit, students also gradually learn strategies for handling integration involving more complicated functions.	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	• RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision. • CRITICAL THINKING: Demonstrate flexibility and determination when problem solving. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Calculus uses limits to understand and model sums of infinitely many, infinitesimally small pieces. • Differentiation has an inverse operation that can be used to model with functions, analyze graphs, and draw conclusions from data in a table.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • How do we use limits to extend concepts from Algebra?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
Area of regions can be approximated by filling the region with rectangles. To gain better approximations we use smaller and smaller rectangles to fill in the gaps. We can use limits to find the exact area of these regions by making the rectangles infinitesimally small.	1. I can approximate the area under a curve using rectangles of a given width. 2. I can write Riemann Sums using summation notation and definite integrals and evaluate these sums. 3. I can apply the fundamental theorem of calculus to evaluate definite integrals.

The fundamental theorem of calculus relates two seemingly unrelated ideas giving us the ability to use antidifferentiation to evaluate limits of infinite sums.	4. I can evaluate antiderivatives and use integration notation. 5. I can use properties of integration to solve problems. 6. I can apply basic integration rules to a given function. 7. I can use u-substitution to evaluate definite integrals. 8. I can write and evaluate definite integrals to solve real-world problems.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Calculus Unit 4 Test 1. I can approximate the area under a curve using rectangles of a given width. Test Question: #13 2. I can write Riemann Sums using summation notation and definite integrals and evaluate these sums. Test Question: #8 3. I can apply the fundamental theorem of calculus to evaluate definite integrals. Test Question: #1, #2, #4, #11 4. I can evaluate antiderivatives and use integration notation. Test Question: #9, #10 5. I can use properties of integration to solve problems. Test Question: #3, #9 6. I can apply basic integration rules to a given function. Test Question: #4, #5, #6, #7, #10, #12 7. I can use u-substitution to evaluate definite integrals. Test Question: #5, #6 8. I can write and evaluate definite integrals to solve real-world problems. Test Question: #9, #10, #11	Quizzes Curated Practice Problem Sets
STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	

First Unit Topic: Summations	Estimated # of Lessons: 6
Learning Target(s): 1. I can approximate the area under a curve using rectangles of a given width. 2. I can write Riemann Sums using summation notation and definite integrals and evaluate these sums. 5. I can use properties of integration to solve problems.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How do we use limits to extend concepts from Algebra?
Learning Activities: 1. Use rectangles to approximate area of regions not defined by common geometrical shapes. 2. Use sigma and integration notation to model area. 3. Develop properties of integration to solve problems.	
CollegeBoard AP Calculus AB Course and Exam Description	

Second Unit Topic: Anti-Derivatives and the Fundamental Theorem of Calculus	Estimated # of Lessons: 7
Learning Target(s): 3. I can apply the fundamental theorem of calculus to evaluate definite integrals. 4. I can evaluate antiderivatives and use integration notation. 5. I can use properties of integration to solve problems. 6. I can apply basic integration rules to a given function. 7. I can use u-substitution to evaluate definite integrals. 8. I can write and evaluate definite integrals to solve real-world problems.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How do we use limits to extend concepts from Algebra?
Learning Activities: 1. Beginning with problems that are simple enough to "guess and check," determine the original function when given its derivative. Formalize strategies into basic rules for differentiation. 2. Given example anti-derivatives, some correct and some incorrect, notice patterns that will evolve into the strategy of using substitution to integrate.	

3. In a class discussion, and using a motion problem as an example, conceptually connect the anti-derivative and the definite integral. Formalize this as the fundamental theorem of calculus.
CollegeBoard AP Calculus AB Course and Exam Description

<table>
<tr><td colspan="2">COURSE NAME: Calculus Unit Title: Applications of Integration
Est. Time: 8 Weeks (10 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students are introduced to other applications of integration, including finding the volume of a 3-D solid and finding the area of a region bounded by multiple functions. They also continue to investigate the connections between position, velocity, and acceleration.</td></tr>
<tr><td colspan="2">STAGE 1 ⟶ IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
N/A</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when problem solving.
MP #1: Make sense of problems and persevere in solving them.
MP #2: Reason abstractly and quantitatively.
MP #6: Attend to precision.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Integrals can be used to find sums in many different contexts, as long as we can model the values with a function.</td><td>● How do we use limits to extend concepts from Algebra?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>The net change in a quantity, the area of a region, and the volume of a solid can all be found by adding up many, infinitesimally small parts.</td><td>1. I can use integrals to model and calculate the position, velocity, and acceleration of an object.
2. I can use integrals to calculate the area between two or more curves.
3. I can use integrals to calculate the volume of a 3-D solid with a known cross section and base region.
4. I can use integrals to calculate the volume of a 3-D solid of revolution (disc method).
5. I can use integrals to calculate the volume of a 3-D solid of revolution with empty space in it (washer method).</td></tr>
</table>

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Calculus Unit 6 Test 1. I can use integrals to model and calculate the position, velocity, and acceleration of an object. Test Question: #8 2. I can use integrals to calculate the area between two or more curves. Test Question: #1, #2 3. I can use integrals to calculate the volume of a 3-D solid with a known cross section and base region. Test Question: #4, #7 4. I can use integrals to calculate the volume of a 3-D solid of revolution (disc method). Test Question: #3 5. I can use integrals to calculate the volume of a 3-D solid of revolution with empty space in it (washer method). Test Question: #5, #6	Quizzes Curated Practice Problem Sets
STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	

First Unit Topic: Applications of Integration	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can use integrals to model and calculate the position, velocity, and acceleration of an object. 2. I can use integrals to calculate the area between two or more curves. 3. I can use integrals to calculate the volume of a 3-D solid with a known cross section and base region. 4. I can use integrals to calculate the volume of a 3-D solid of revolution (disc method). 5. I can use integrals to calculate the volume of a 3-D solid of revolution with empty space in it (washer method).	**Essential Questions:** ● How do we use limits to extend concepts from Algebra?
Learning Activities: 1. Work in groups to develop their own strategies for finding the areas of regions of increasing complexity.	

2. Use computer animations and physical objects to visualize what a solid of revolution is and how we can think of it as being made up of many small slices, then develop a method for modeling the volume of each of these slices.
CollegeBoard AP Calculus AB Course and Exam Description

COURSE NAME: Calculus **Unit Title: Limits and Continuity**
Est. Time:7 Weeks (12 lessons, meets every other day)

OVERVIEW
In this unit, students will continue to work with limits. Limits introduce the subtle distinction between evaluating a function at a point and considering what value the function is approaching, if any, as x approaches a point. This distinction allows us to extend understanding of asymptotes and holes in graphs with formal definitions of continuity.

STAGE 1 ⟶ IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	TRANSFER
CSDE Content Standards: **N/A**	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Calculus uses limits to understand and model dynamic change. ● Limits can be found graphically, numerically, and analytically and selecting the appropriate strategy allows for more efficient problem solving.	● Can change occur at an instant? ● How do we use limits to extend concepts from Algebra? ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
The limit of a function is the value that the function becomes arbitrarily close to as its input becomes sufficiently close to some real number.	1. I can estimate the value of a limit from a graphical or tabular representation. 2. I can determine the precise value of a limit using algebraic manipulation. 3. I can determine the continuity of a function using limits. 4. I can apply the squeeze theorem to evaluate a limit. 5. I can determine if a limit will exist. 6. I can select and apply an appropriate strategy for evaluating a limit. 7. I can use limits to analyze the asymptotes and end behavior of a function.

<table>
<tr><th colspan="2">STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 1 Test - Limits

1. I can estimate the value of a limit from a graphical or tabular representation.
Test Question: #4, #16
2. I can determine the precise value of a limit using algebraic manipulation.
Test Question: #1, #6, #7, #8, #9, #15
3. I can determine the continuity of a function using limits.
Test Question: #2, #3, #5, #14
4. I can apply the squeeze theorem to evaluate a limit.
Test Question: #12
5. I can determine if a limit will exist.
Test Question: #4, #10
6. I can select an appropriate strategy for evaluating a limit.
Test Question: #7, #8, #10, #11, #12
7. I can use limits to analyze the asymptotes and end behavior of a function.
Test Question: #4, #10, #11, #13</td><td>Ongoing Assessment: CollegeBoard AP Questions Practice

Unit 1 Quizzes
Group Quizzes
Exit Slips</td></tr>
<tr><td>STAGE 3 □ LEARNING PLAN EXPERIENCES AND INSTRUCTION</td><td></td></tr>
<tr><td>● Performance Task: Students will be given graphs of two functions and have to apply their conceptual understanding of limits to evaluate complicated limits involving composite functions. Students will be able to self-assess as they go through the problems, because for each set of 3 questions, two will match and one will be the “odd one out.”
● Critical Thinking: Demonstrate flexibility and determination when solving problems.
● Understandings: #2
● Learning Targets: #1, #5, #7</td><td></td></tr>
</table>

<table>
<tr><th>First Unit Topic: Basic Strategies for Evaluating Limits</th><th>Estimated # of Lessons: 6</th></tr>
<tr><td>Learning Target(s):

1. I can estimate the value of a limit from a graphical or tabular representation.
2. I can determine the precise value of a limit using algebraic manipulation.
3. I can determine the continuity of a function using limits.</td><td>Essential Questions:

● Can change occur at an instant?
● How do we use limits to extend concepts from Algebra?
● How can representing the same mathematical relationship in different</td></tr>
</table>

5. I can determine if a limit will exist.	ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Refresh on the concept of a limit in the new context of rate of change. 2. Review estimating limits graphically through student-led problem solving. 3. Analyze the graphs of rational functions to begin evaluating limits analytically. 4. Define continuity in terms of limits and use this to analyze continuity analytically (rather than using a graph or table).	
CollegeBoard AP Calculus AB Course and Exam Description	

Second Unit Topic: Other Strategies for Evaluating Limits	**Estimated # of Lessons: 6**
Learning Target(s): 4. I can apply the squeeze theorem to evaluate a limit. 5. I can determine if a limit will exist. 6. I can select and apply an appropriate strategy for evaluating a limit. 7. I can use limits to analyze the asymptotes and end behavior of a function.	**Essential Questions:** ● How do we use limits to extend concepts from Algebra? ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Introduce the squeeze theorem through geometric examples, then look at algebraic problems where it can be applied. 2. Using functions with familiar options available for algebraic manipulation, introduce other strategies for evaluating limits analytically. 3. Graphically explore how limits connect to asymptotes and end behavior of functions. Specifically discuss the existence (or non-existence) of limits at these graphical features.	
CollegeBoard AP Calculus AB Course and Exam Description	

COURSE NAME: Calculus Unit Title: Differentiation Est. Time:7 Weeks (12 lessons, meets every other day)	
OVERVIEW In this unit students will develop methods to calculate instantaneous rate of change. Students first learn the limit definition of derivatives then develop shortcut methods to differentiate different types of functions. Then students learn how to differentiate composite functions using the chain rule and apply that understanding to determine derivatives of implicit and inverse functions	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	• CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Calculus uses limits to understand and model dynamic change. • Derivatives can be found with limits using the slope equation or by different derivative rules. The appropriate strategy allows for more efficient problem solving. • The chain rule can be used to differentiate implicit equations to find rate the rate of change of different relations.	• Can change occur at an instant? • How do we use limits to extend concepts from Algebra? • How can we find rate of change of equations with two variables?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
The rate of change at an instant can be evaluated by finding the rate of change over an interval that is infinitesimally small using limits and algebraic manipulation. Using algebra, we can derive shortcut methods to differentiating different classes functions. The chain rule allows us to differentiate composite functions and implicit relations.	1. I can estimate the rate of change from a graphical or tabular representation. 2. I can determine the precise value of the rate of changed of a relation at a point using algebraic manipulation. 3. I can write the equations of tangent lines and locate at which point the derivative is a specific value 4. I can determine when derivatives do and do not exist. 5. I can apply the power rule, product rule, quotient rule, and chain rule.

	6. I can apply derivatives to transcendental functions 7. I can select an appropriate strategy for differentiating relations. 8. I can differentiate implicit equations. 9. I can differentiate inverse functions 10. I can find higher-order derivatives

<table>
<tr><th colspan="2">STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 2 Calculus Test

1. I can estimate the rate of change from a graphical or tabular representation.
Test Question: #7
2. I can determine the precise value of the rate of changed of a relation at a point
Test Question: #8
3. I can write the equations of tangent lines and locate at which point the derivative is a specific value
Test Question: #1
4. I can determine when derivatives do and do not exist.
Test Question: #9
5. I can apply the power rule, product rule, quotient rule, and chain rule.
Test Question: #3
6. I can apply derivatives to transcendental functions
Test Question: #6
7. I can select an appropriate strategy for differentiating relations.
Test Question: #1, #2
8. I can differentiate implicit equations.
Test Question: #2
9. I can differentiate inverse functions
Test Question: #5
10. I can find higher-order derivatives
Test Question: #4</td><td>Ongoing Assessment: CollegeBoard AP Questions (Secure Documents)

Unit 2 Quizzes
Group Quizzes
Exit Slips</td></tr>
<tr><th>STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION</th><th></th></tr>
<tr><td>● Performance Task: Each student is given a function and are asked to find the function’s derivative using one or more derivative rules. After checking their answers ask half of the class to redo their work to include an error, thus having the wrong answer. Ask students to record their correct or incorrect work on a card. Mix up the cards and redistribute, having students determine if the answer is correct or incorrect. If incorrect, they explain what error was made, and find the correct answer.
● Transfer Skills: CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.
● Understandings: #2
● Learning Targets: #2, #5, #6, #7</td><td></td></tr>
</table>

First Unit Topic: Rate of Change at an Instant	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can estimate the rate of change from a graphical or tabular representation. 2. I can determine the precise value of the rate of changed of a relation at a point using algebraic manipulation. 3. I can write the equations of tangent lines and locate at which point the derivative is a specific value 4. I can determine when derivatives do and do not exist. 5. I can apply the power rule, product rule, quotient rule, and chain rule. 6. I can apply derivatives to transcendental functions.	**Essential Questions:** ● Can change occur at an instant? ● How do we use limits to extend concepts from Algebra?
Learning Activities: 1. Refresh on the concept of a limit in the new context of rate of change. 2. Develop and apply general derivative rules for different categories of functions. 3. Analyze graphs to approximate rate of change and identify differentiability.	
CollegeBoard AP Calculus AB Course and Exam Description	

Second Unit Topic: Strategies for Differentiation	**Estimated # of Lessons: 6**
Learning Target(s): 7. I can select an appropriate strategy for differentiating relations. 8. I can differentiate implicit equations. 9. I can differentiate inverse functions. 10. I can find higher-order derivatives.	**Essential Questions:** ● How do we use limits to extend concepts from Algebra? ● How can we find rate of change of equations with two variables?
Learning Activities: 1. Develop and apply derivative rules for transcendental and inverse functions. 2. Develop and apply methods for differentiating implicit relations. 3. Apply derivative rules given the graph of a function. 4. Apply derivative rules to find higher-order derivatives.	
CollegeBoard AP Calculus AB Course and Exam Description	

COURSE NAME: Calculus Unit Title: Applications of Differentiation Est. Time: 7 Weeks (13 lessons, meets every other day)	
OVERVIEW In this unit students begin by developing understanding of average and instantaneous rates of change in problems involving motion. The unit then identifies differentiation as a common underlying structure on which to build understanding of change in a variety of contexts. Students' understanding of units of measure often reinforces their understanding of contextual applications of differentiation. In problems involving related rates, identifying the independent variable common to related functions may help students to correctly apply the chain rule. When applying differentiation to determine limits of certain indeterminate forms using L'Hospital's rule, students must show that the rule applies. Then the superficial details of contextual applications of differentiation are stripped away to focus on abstract structures and formal conclusions. Reasoning with definitions and theorems establishes that answers and conclusions are more than conjectures; they have been analytically determined. As when students showed supporting work for answers in previous units, students will learn to present justifications for their conclusions about the behavior of functions over certain intervals or the locations of extreme values or points of inflection. The unit concludes this study of differentiation by applying abstract reasoning skills to justify solutions for realistic optimization problems.	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	• RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision. • CRITICAL THINKING: Demonstrate flexibility and determination when problem solving. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Calculus uses limits to understand and model dynamic change. • Differentiation is a common underlying structure applied in common real-world situations that change over time • Use strict definitions and theorems to draw conclusions about a given function	• Can change occur at an instant? • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • How can we connect functional representations to graphical representations?

KNOWLEDGE	SKILLS (framed as Learning Targets)
• Given a function and what we know about the first and second derivative we can find key features of a graph. • Given situation with multiple variables students can find relationships between them to solve real-world problems.	1. I can find intervals of increasing/ decreasing, critical points and relative extrema analytically and graphically. 2. I can find intervals of concavity and points of inflection analytically and graphically. 3. I can solve problems involving linear particle motion. 4. I can sketch graphs of functions and derivatives given graphs of the derivatives or functions respectively. 5. I can apply the mean value theorem to solve problems. 6. I can apply rate of change to real world problems (related rates/ optimization)

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 3 Test 1. I can find intervals of increasing/ decreasing, critical points and relative extrema analytically and graphically. Test Question: #1, #4, #5, #6, #7, #9, #11, #15 2. I can find intervals of concavity and points of inflection analytically and graphically. Test Question: #1, #7, #9, #10, 14 3. I can solve problems involving linear particle motion. Test Question: #2 4. I can sketch graphs of functions and derivatives given graphs of the derivatives or functions respectively. Test Question: #3, #9, 14 5. I can apply the mean value theorem to solve problems. Test Question: #8 6. I can apply rate of change to real world problems (related rates/ optimization) Test Question: #12, #13, #16, #17	Ongoing Assessment: CollegeBoard AP Questions (Secure Documents) Unit 3 Quizzes Group Quizzes Exit Slips
STAGE 3 □ LEARNING PLAN EXPERIENCES AND INSTRUCTION	
• **Performance Task:** Students find a simple three-dimensional container, find the dimensions and the optimal dimensions using calculus. Then, if the containers dimensions are not optimal (can hold the most volume using the least material) students must come up with reasons why a particular company does not use these efficient dimensions. Finally, students must present and defend their findings to the class. • Transfer Skills: Synthesize information to solve problems and defend claims. • Understandings: #2 • Learning Targets: #1, #6	

First Unit Topic: Contextual Applications of Derivatives	**Estimated # of Lessons: 6**
Learning Target(s): 3. I can solve problems involving linear particle motion.	**Essential Questions:** • Can change occur at an instant? • How can representing the same mathematical relationship in different

6. I can apply rate of change to real world problems (related rates)	ways allow us to model real-world scenarios and solve problems?

Learning Activities:

- Use relationships to develop and apply methods for solving problems involving how quantities change over time.

CollegeBoard AP Calculus AB Course and Exam Description

Second Unit Topic: Analytic Applications of Derivatives	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can find intervals of increasing/ decreasing, critical points and relative extrema analytically and graphically. 2. I can find intervals of concavity and points of inflection analytically and graphically. 4. I can sketch graphs of functions and derivatives given graphs of the derivatives or functions respectively. 5. I can apply the mean value theorem to solve problems. 6. I can apply rate of change to real world problems (optimization)	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How can we connect functional representations to graphical representations?

Learning Activities:

1. Define intervals of increasing and decreasing, critical points, and relative extrema.
2. Use previous definitions, theorems and tests to find intervals if increasing and decreasing and relative extrema analytically and graphically.
3. Define concavity and points of inflection and use the definitions to solve problems.
4. Curve sketching
5. Find optimal quantities for given real-world problems.

CollegeBoard AP Calculus AB Course and Exam Description

COURSE NAME: Calculus Unit Title: Integration Est. Time: 7 Weeks (13 lessons, meets every other day)	
OVERVIEW In this unit, students are initially introduced to the anti-derivative and the definite integral as two separate concepts for undoing a derivative and finding a sum, respectively. As they move through the unit, they see, through shared notation and through application problems, that the two concepts are connected. Eventually, students begin using the Fundamental Theorem of Calculus to find definite integrals using anti-derivatives. As they progress through the unit, students also gradually learn strategies for handling integration involving more complicated functions.	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **N/A**	● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims. MP #2: Reason abstractly and quantitatively. MP #6: Attend to precision. ● CRITICAL THINKING: Demonstrate flexibility and determination when problem solving. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Calculus uses limits to understand and model sums of infinitely many, infinitesimally small pieces. ● Differentiation has an inverse operation that can be used to model with functions, analyze graphs, and draw conclusions from data in a table.	● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? ● How do we use limits to extend concepts from Algebra?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
Area of regions can be approximated by filling the region with rectangles. To gain better approximations we use smaller and smaller rectangles to fill in the gaps. We can use limits to find the exact area of these regions by making the rectangles infinitesimally small.	1. I can approximate the area under a curve using rectangles of a given width. 2. I can write Riemann Sums using summation notation and definite integrals and evaluate these sums. 3. I can apply the fundamental theorem of calculus to evaluate definite integrals.

The fundamental theorem of calculus relates two seemingly unrelated ideas giving us the ability to use antidifferentiation to evaluate limits of infinite sums.	4. I can evaluate antiderivatives and use integration notation. 5. I can use properties of integration to solve problems. 6. I can apply basic integration rules to a given function. 7. I can use u-substitution to evaluate definite integrals. 8. I can write and evaluate definite integrals to solve real-world problems.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Calculus Unit 4 Test 1. I can approximate the area under a curve using rectangles of a given width. Test Question: #13 2. I can write Riemann Sums using summation notation and definite integrals and evaluate these sums. Test Question: #8 3. I can apply the fundamental theorem of calculus to evaluate definite integrals. Test Question: #1, #2, #4, #11 4. I can evaluate antiderivatives and use integration notation. Test Question: #9, #10 5. I can use properties of integration to solve problems. Test Question: #3, #9 6. I can apply basic integration rules to a given function. Test Question: #4, #5, #6, #7, #10, #12 7. I can use u-substitution to evaluate definite integrals. Test Question: #5, #6 8. I can write and evaluate definite integrals to solve real-world problems. Test Question: #9, #10, #11	Ongoing Assessment: CollegeBoard AP Questions (Secure Documents) Unit 4 Quizzes Group Quizzes Exit Slips
STAGE 3 □ LEARNING PLAN EXPERIENCES AND INSTRUCTION	

• **Performance Task:** In small groups students will be given a set of three or four indefinite integrals. In the set, one integral will require a different strategy to evaluate than the others. Students will identify the "odd one out" then explain which strategy each integral requires and why. They will repeat this process for several sets of problems. • Transfer Skills: Synthesize information to solve problems and defend claims. • Understandings: #2 • Learning Targets: #4, #6, #7	

First Unit Topic: Summations	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can approximate the area under a curve using rectangles of a given width. 2. I can write Riemann Sums using summation notation and definite integrals and evaluate these sums. 5. I can use properties of integration to solve problems.	**Essential Questions:** • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • How do we use limits to extend concepts from Algebra?
Learning Activities: 1. Use rectangles to approximate area of regions not defined by common geometrical shapes. 2. Use sigma and integration notation to model area. 3. Develop properties of integration to solve problems.	
CollegeBoard AP Calculus AB Course and Exam Description	

Second Unit Topic: Anti-Derivatives and the Fundamental Theorem of Calculus	**Estimated # of Lessons: 7**
Learning Target(s): 3. I can apply the fundamental theorem of calculus to evaluate definite integrals. 4. I can evaluate antiderivatives and use integration notation. 5. I can use properties of integration to solve problems. 6. I can apply basic integration rules to a given function. 7. I can use u-substitution to evaluate definite integrals.	**Essential Questions:** • How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems? • How do we use limits to extend concepts from Algebra?

8. I can write and evaluate definite integrals to solve real-world problems.	
Learning Activities: 1. Beginning with problems that are simple enough to "guess and check," determine the original function when given its derivative. Formalize strategies into basic rules for differentiation. 2. Given example anti-derivatives, some correct and some incorrect, notice patterns that will evolve into the strategy of using substitution to integrate. 3. In a class discussion, and using a motion problem as an example, conceptually connect the anti-derivative and the definite integral. Formalize this as the fundamental theorem of calculus.	
CollegeBoard AP Calculus AB Course and Exam Description	

<table>
<tr><td colspan="2">COURSE NAME: Calculus Unit Title: Differential Equations
Est. Time: 6 Weeks (5 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students begin modeling situations involving differential equations. They also draw slope fields to graphically represent these equations and use the slope fields to analyze how a quantity of interest is changing. Finally, students solve differential equations to find an explicit model for a quantity of interest.</td></tr>
<tr><td colspan="2">STAGE 1 ⟶ IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
N/A</td><td>● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #2: Reason abstractly and quantitatively.
● CRITICAL THINKING: Demonstrate flexibility and determination when problem solving.
MP #1: Make sense of problems and persevere in solving them.
MP #6: Attend to precision.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Calculus uses limits to understand and model dynamic change.
● Some situations are easier to model by first determining how a quantity is changing as a function of other quantities, then using this relationship to explicitly represent the situation.</td><td>● Can change occur at an instant?
● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>The rate of change of a quantity can depend on various inputs, including the quantity itself.</td><td>1. I can write a differential equation to model a real-world situation.
2. I can draw a slope field to graphically represent a differential equation.
3. I can use slope fields to analyze a differential equation and its solution.
4. I can find general and particular solutions to differential equations using separation of variables.
5. I can model situations involving exponential functions by solving a</td></tr>
</table>

	differential equation.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Calculus Unit 5 Test 1. I can write a differential equation to model a real-world situation. Test Question: #9 2. I can draw a slope field to graphically represent a differential equation. Test Question: #6 3. I can use slope fields to analyze a differential equation and its solution. Test Question: #4, #5, #6, #7 4. I can find general and particular solutions to differential equations using separation of variables. Test Question: #1, #2, #3, #7, #8 5. I can model situations involving exponential functions by solving a differential equation. Test Question: #9	Ongoing Assessment: CollegeBoard AP Questions (Secure Documents) Unit 5 Quizzes Group Quizzes Exit Slips
STAGE 3 ▯ LEARNING PLAN EXPERIENCES AND INSTRUCTION	
● **Performance Task:** Students are given a description of a sphere with changing size and must model it using a differential equation. They then solve this differential equation to model the radius of the sphere. The problem is set up in a way that there are multiple approaches that seem reasonable, involving strategies from this and previous units. However, some of the strategies do not work, so students must defend their strategy in a class discussion. ● Transfer Skills: Synthesize information to solve problems and defend claims. ● Understandings: #2 ● Learning Targets: #1, #4	

First Unit Topic: Differential Equations	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can write a differential equation to model a real-world situation. 2. I can draw a slope field to graphically represent a differential equation. 3. I can use slope fields to analyze a differential equation and its solution.	**Essential Questions:** ● Can change occur at an instant? ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?

4. I can find general and particular solutions to differential equations using separation of variables. 5. I can model situations involving exponential functions by solving a differential equation.	
Learning Activities: 1. Gradually introduce solving differential equations using separation of variables by beginning with problems that can already be solved using basic integration, then transitioning to problems that require more sophisticated algebraic manipulation. 2. Display a simple differential equation and have students explain in words what the differential equation tells us. Then, move to differential equations with real-world context.	
CollegeBoard AP Calculus AB Course and Exam Description	

<table>
<tr><td colspan="2">COURSE NAME: Calculus   Unit Title: Applications of Integration
Est. Time: 6 Weeks (10 lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students are introduced to other applications of integration, including finding the volume of a 3-D solid and finding the area of a region bounded by multiple functions. They also continue to investigate the connections between position, velocity, and acceleration.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
N/A</td><td>● CRITICAL THINKING: Demonstrate flexibility and determination when problem solving.
MP #1: Make sense of problems and persevere in solving them.
MP #2: Reason abstractly and quantitatively.
MP #6: Attend to precision.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Integrals can be used to find sums in many different contexts, as long as we can model the values with a function.</td><td>● How do we use limits to extend concepts from Algebra?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>The net change in a quantity, the area of a region, and the volume of a solid can all be found by adding up many, infinitesimally small parts.</td><td>1. I can use integrals to model and calculate the position, velocity, and acceleration of an object.
2. I can use integrals to calculate the area between two or more curves.
3. I can use integrals to calculate the volume of a 3-D solid with a known cross section and base region.
4. I can use integrals to calculate the volume of a 3-D solid of revolution (disc method).
5. I can use integrals to calculate the volume of a 3-D solid of revolution with empty space in it (washer method).</td></tr>
</table>

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Calculus Unit 6 Test 1. I can use integrals to model and calculate the position, velocity, and acceleration of an object. Test Question: #8 2. I can use integrals to calculate the area between two or more curves. Test Question: #1, #2 3. I can use integrals to calculate the volume of a 3-D solid with a known cross section and base region. Test Question: #4, #7 4. I can use integrals to calculate the volume of a 3-D solid of revolution (disc method). Test Question: #3 5. I can use integrals to calculate the volume of a 3-D solid of revolution with empty space in it (washer method). Test Question: #5, #6	Ongoing Assessment: CollegeBoard AP Questions (Secure Documents) Group Assessments Curated Practice Problem Sets
STAGE 3 ▯ LEARNING PLAN EXPERIENCES AND INSTRUCTION	
● **Performance Task:** In groups of four, each student will be given a paper with the same four-part AP free-response question on it. Each student will complete the first part, then pass the paper to their left. They will check the first step, then complete the second step. They repeat this process until all four steps are completed and they have their own paper back. ● Critical Thinking: Demonstrate flexibility and determination when problem solving. ● Understandings: #1 ● Learning Targets: #2, #5	

First Unit Topic: Applications of Integration	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can use integrals to model and calculate the position, velocity, and acceleration of an object. 2. I can use integrals to calculate the area between two or more curves.	**Essential Questions:** ● How do we use limits to extend concepts from Algebra?

3. I can use integrals to calculate the volume of a 3-D solid with a known cross section and base region. 4. I can use integrals to calculate the volume of a 3-D solid of revolution (disc method). 5. I can use integrals to calculate the volume of a 3-D solid of revolution with empty space in it (washer method).	
Learning Activities: 1. Work in groups to develop their own strategies for finding the areas of regions of increasing complexity. 2. Use computer animations and physical objects to visualize what a solid of revolution is and how we can think of it as being made up of many small slices, then develop a method for modeling the volume of each of these slices.	
CollegeBoard AP Calculus AB Course and Exam Description	

COURSE NAME: AP Statistics Unit 1: Exploring One-Variable Data Est. Time: 5 Weeks (7-8 Lessons, meets every other day)	
OVERVIEW *In this unit, students will define and represent categorical and quantitative variables, describe, and compare distributions of one-variable data, and interpret statistical calculations to assess claims about individual data points or samples. Students will also begin to apply the normal distribution model as an introduction to how theoretical models for populations can be used to describe some distributions of sample data.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: ● HHS.ID.A: Summarize, represent, and interpret data on a single count or measurement variable.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. ● CRITICAL THINKING: Identify a problem, ask key questions, and make a prediction. MP#1 Make sense of problems and persevere in solving them. MP#6 Attend to precision.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Given that variation may be random or not, conclusions are uncertain. ● Graphical representations and statistics allow us to identify and represent key features of data. ● Generally, the normal curve can be used to understand random behavior.	● What statistical measurements could be used to describe a data set? ● What patterns do I see in this data set? ● How certain are we that what seems to be a pattern is not just a coincidence?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to represent one variable data in multiple ways (graphically, frequency table, lists, visually) How to describe one variable data (shape, outlier, center, spread) How to compare distributions from graphical representations or summary statistics	1. I can describe data presented numerically or graphically 2. I can construct numerical or graphical representations of distributions. 3. I can calculate summary statistics (minimum, first quartile, median, third quartile, maximum). 4. I can compare distributions or relative positions of points within a distribution. 5. I can interpret statistical calculations and findings to assign meaning or assess a claim.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: Exploring One-Variable Data Unit 1 Assessment 1. I can describe data presented numerically or graphically Questions: #1, #4, #7, #11 2. I can construct numerical or graphical representations of distributions. Questions: #3, #5, #11, #12, #13 3. I can calculate summary statistics. Questions: #5, #12 4. I can compare distributions or relative positions of points within a distribution. Questions: #6, #7, #8, #11, #13 5. I can interpret statistical calculations and findings to assign meaning or assess a claim. Questions: #1, #2, #6, #7, #8, #9, #11	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)

• **Performance Task:** Students work collaboratively to determine if the class can determine the difference between Coke and Pepsi in a blind taste test using the Essential Question: How certain are we that what seems to be a pattern is not just a coincidence? • Transfer Skills: Critical Thinking • Understandings: #1, 2 • Learning Targets: #5	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Variation and Distribution: Selecting Statistical Methods	**Estimated # of Lessons: 1**
Learning Target(s): 5. I can interpret statistical calculations and findings to assign meaning or assess a claim.	**Essential Questions:** • What can be learned from data? • How certain are we that what seems to be a pattern is not just a coincidence?
Learning Activities: 1. Classroom Activity: Coke vs Pepsi.	
College Board AP Statistics Course and Exam Description	

Second Unit Topic: Patterns and Uncertainty: Data Analysis	**Estimated # of Lessons: 8**
Learning Target(s): 1. I can describe data presented numerically or graphically 2. I can construct numerical or graphical representations of distributions. 3. I can calculate summary statistics, relative positions of points within a distribution, correlation, and predicted response.	**Essential Questions:** • What can be learned from data? • How certain are we that what seems to be a pattern is not just a coincidence?

4. I can compare distributions or relative positions of points within a distribution. 5. I can interpret statistical calculations and findings to assign meaning or assess a claim.	
Learning Activities: 1. Represent data (categorical and quantitative) using tables and graphs. 2. Describe data using SOCS (Shape, Outlier, Center, Spread) with context. 3. Determine summary statistics (five number summary) with context. 4. Compare distributions using graphs and summary statistics with context.	
College Board AP Statistics Course and Exam Description	

Second Unit Topic: The Normal Distribution	**Estimated # of Lessons: 1**
Learning Target(s): 1. I can describe data presented numerically or graphically 2. I can construct numerical or graphical representations of distributions. 3. I can calculate summary statistics, relative positions of points within a distribution, correlation, and predicted response. 4. I can compare distributions or relative positions of points within a distribution. 5. I can interpret statistical calculations and findings to assign meaning or assess a claim.	**Essential Questions:** • What can be learned from data? • How certain are we that what seems to be a pattern is not just a coincidence?
Learning Activities: 1. Compare distributions or relative positions of points within a distribution. 2. Determine relative frequencies, proportions or probabilities using simulation or calculations.	
College Board AP Statistics Course and Exam Description	

COURSE NAME: AP Statistics **Unit 2: Exploring Two-Variable Data**
Est. Time: 6 Weeks (9 Lessons, meets every other day)

OVERVIEW
In this unit, students will describe form, direction, strength, and unusual features for an association between two quantitative variables. They will assess correlation and, if appropriate, use a linear model to predict values of the response variable from values of the explanatory variable. Students will interpret the least-squares regression line in context, analyze prediction errors (residuals), and explore departures from a linear pattern.

STAGE 1 ⟶ IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	TRANSFER
CCSS Content Standards: ● HHS.ID.B: Summarize, represent, and interpret data on two categorical and quantitative variables. ● HHS.ID.C: Interpret linear models.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. ● CRITICAL THINKING: Identify a problem, ask key questions, and make a prediction. MP#1 Make sense of problems and persevere in solving them. MP#6 Attend to precision.

UNDERSTANDINGS	ESSENTIAL QUESTIONS
● Given that variation may be random or not, conclusions are uncertain. ● Graphical representations and statistics allow us to identify and represent key features of data. ● Regression models may allow us to predict responses to changes in an explanatory variable.	● What statistical measurements could be used to describe a data set? ● What patterns do I see in this data set? ● How certain are we that what seems to be a pattern is not just a coincidence? ● How can you determine the effectiveness of a linear model?

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to represent two variable data in multiple ways (graphically, frequency table, lists, visually) How to describe two variable data (direction, outliers, form, strength) How to compare distributions from graphical representations or summary statistics	1. I can describe data presented numerically or graphically 2. I can construct numerical or graphical representations of distributions. 3. I can calculate summary statistics (correlation R-value, slope, y-intercept) 4. I can interpret statistical calculations and findings to assign meaning or assess a claim.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Test: Exploring Two-Variable Data Unit 2 Assessment 1. I can describe data presented numerically or graphically Questions: #1, #5, #7, #8, #11 2. I can construct numerical or graphical representations of distributions. Questions: #11 3. I can calculate summary statistics, relative positions of points within a distribution, correlation, and predicted response. Questions: #3, #4, #5, #6, #10, #11, #12 4. I can interpret statistical calculations and findings to assign meaning or assess a claim. Questions: #2, #5, #6, #7, #9, #11, #12	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)
• **Performance Task:** Students work collaboratively to who stole the cookie from the cookie jar by reviewing class data to compare with a list of suspects using the Essential Question: How certain are we that what seems to be a pattern is not just a coincidence? • Transfer Skills: Critical Thinking • Understandings: #1	

• Learning Targets: #4	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Scatterplots and Correlation	**Estimated # of Lessons: 3**
Learning Target(s): 1. I can describe data presented numerically or graphically 2. I can construct numerical or graphical representations of distributions. 3. I can calculate summary statistics, relative positions of points within a distribution, correlation, and predicted response. 4. I can interpret statistical calculations and findings to assign meaning or assess a claim.	**Essential Questions:** • What statistical measurements could be used to describe a data set? • What patterns do I see in this data set?
Learning Activities: 1. Who stole the cookies from the cookie jar? Activity. Allows to identify the question to be answered or problem to be solved. 2. Develop and describe scatterplots with two variables. 3. Calculate and interpret correlation between two variables.	
College Board AP Statistics Course and Exam Description	

Second Unit Topic: Least-Squares Regression	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can describe data presented numerically or graphically 2. I can construct numerical or graphical representations of distributions. 3. I can calculate summary statistics, relative positions of points within a distribution, correlation, and predicted	**Essential Questions:** • What statistical measurements could be used to describe a data set? • What patterns do I see in this data set?

response. 4. I can interpret statistical calculations and findings to assign meaning or assess a claim.	• How certain are we that what seems to be a pattern is not just a coincidence? • How can you determine the effectiveness of a linear model?
Learning Activities: 1. Calculate and interpret slope with context. 2. Calculate and interpret outliers and influential points and describe how they impact slope, y-intercepts, and the standard deviation of the residuals when they are removed with context. 3. Calculate and interpret residuals with context. 4. Determine the equation of the least squares regression line and a residual plot from technology. 5. Interpret the standard deviation of the residuals and the coefficient of determination. 6. Determine the LSRL from the mean and standard deviations of the x- & y-variables.	
College Board AP Statistics Course and Exam Description	

COURSE NAME: AP Statistics Unit 3: Collecting Data Est. Time: 5 weeks (7 Lessons, meets every other day)	
OVERVIEW *In this unit, students will learn the important principles of sampling and experimental design. Depending on how data are collected, we may or may not be able to generalize findings or establish evidence of causal relationships. For example, if random selection is not used to obtain a sample from a population, bias may result and statistics from the sample cannot be assumed to generalize to the population. For data collected using well-designed experiments, statistically significant differences between or among experimental treatment groups are evidence that the treatments caused the effect.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: ● HHS.ID.B: Summarize, represent, and interpret data on two categorical and quantitative variables. ● HHS.ID.C: Interpret linear models.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. ● RESEARCH AND UNDERSTANDING: Evaluate the bias and validity of information. MP#1 Make sense of problems and persevere in solving them. MP#3 Construct viable arguments and critique the reasoning of others. ● CRITICAL THINKING: Analyze data in order to draw conclusions. MP#3 Construct viable arguments and critique the reasoning of others.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● The way data is collected influences what can or cannot be determined about a population.	● How is bias found in surveys and data collection and how do we overcome it?

• Well-designed experiments can establish evidence of causal relationships. • Bias is evident in many statistical studies and needs to be identified or avoided.	• Why might the data we collect not be valid for drawing conclusions about an entire population?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to plan a study and collect data appropriately. How to identify bias in a study and understand its impacts.	1. I can describe an appropriate method for gathering and representing data. 2. I can identify key and relevant information to answer a question or solve a problem. 3. I can identify types of bias in a study (both sampling and non-sampling bias) and understand its impact on drawing conclusions.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 3 Test: Collecting Data 1. I can describe an appropriate method for gathering and representing data. Questions: #1, #3, #5, #9, #10, #11, #12 2. I can identify key and relevant information to answer a question or solve a problem. Questions: #2, #4, #6, #7, #11, #12 3. I can identify types of bias in a study (both sampling and non-sampling bias) and understand its impact on drawing conclusions. Questions: #4, #8, #13	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)
• **Performance Task:** Students work independently on an activity entitled *Rolling Down the River* that highlights the advantages of	

different sampling methods in lowering variability using *the* Essential Question: Why might the data we collect not be valid for drawing conclusions about an entire population? • Transfer Skills: Critical Thinking • Understandings: #1 • Learning Targets: #1, 2	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Sampling and Surveys	**Estimated # of Lessons: 4**
Learning Target(s): 1. I can describe an appropriate method for gathering and representing data. 2. I can identify key and relevant information to answer a question or solve a problem. 3. I can identify types of bias in a study (both sampling and non-sampling bias) and understand its impact on drawing conclusions.	**Essential Questions:** • How is bias created and how do we overcome it? • Why might the data we collect not be valid for drawing conclusions about an entire population?
Learning Activities: 1. Love is Blind activity to develop an introductory understanding on how collecting data can help make an inference to a population. 2. See no evil, hear no evil activity to look at data that would be statistically significant. 3. Federalist Papers to introduce the idea of simple random samples vs human randomization. 4. Rolling down the river to show the strengths of stratified sampling vs only simple random sampling.	
College Board AP Statistics Course and Exam Description	

Second Unit Topic: Experiments	**Estimated # of Lessons: 3**
Learning Target(s):	**Essential Questions:**

1. I can describe an appropriate method for gathering and representing data. 2. I can identify key and relevant information to answer a question or solve a problem.	• Why might the data we collect not be valid for drawing conclusions about an entire population?
Learning Activities: 1. Caffeine and Pulse Rate to show a completely randomized design. 2. Standing / Sitting pulse rate to highlight blocking/matched pairs design. 3. Distracted Driving to show statistical significance and inference.	
College Board AP Statistics Course and Exam Description	

<table>
<tr><td colspan="2">COURSE NAME: AP Statistics Unit 4: Probability, Random Variables and Probability Distributions
Est. Time: 7 weeks (12 Lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will build on the understandings of simulated or empirical data distributions and fundamental principles of probability to represent, interpret, and calculate parameters for theoretical probability distributions for discrete random variables. Interpretations of probabilities and parameters associated with a probability distribution should use appropriate units and relate to the context of the situation. Simulations and concrete examples can help students to understand the abstract definitions and calculations of probability.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CCSS Content Standards:
● HHS.MD.A: Calculate expected values and use them to solve problems
● HHS.MD.B: Use probability to evaluate outcomes of decisions
● HHS.CP.A: Understand independence and conditional probability and use then to interpret data
● HHS.CP.B: Use the rules of probability to compute probabilities of compound events.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends.
● CRITICAL THINKING: Identify a problem, ask key questions, and make a prediction. MP#1 Make sense of problems and persevere in solving them. MP#6 Attention do precision.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Given that variation may be random or not, conclusions are uncertain.
● Simulations allow us to anticipate patterns in data.
● The likelihood of a random event can be quantified.
● Probability distributions may be used to model variation in populations.</td><td>● How can an event be both random and predictable?
● How can the context of a real-world scenario (normal distribution, binomial distribution, geometric distribution) provide guidance on how to create an equation to model its probability?</td></tr>
</table>

• Probabilistic reasoning allows us to anticipate patterns in data.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use probability and simulation to explore random phenomena. How to leverage statistical augmentation to develop an explanation or justify a conclusion using evidence from data, definitions, or statistical inference.	1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 3. I can determine parameters for probability distributions (geometric, binomial, normal). 4. I can describe probability distributions (mean, standard deviation, transformations).

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 Test: Probability, Random Variables, and Probability Distributions Unit 4 Assessment 1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. Questions: #1, #2, #3, #6, #7, #9, #10, #12, #13 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. Questions: #11 3. I can determine parameters for probability distributions (geometric, binomial, normal).	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)

Questions: #2, #5, #6, #8 4. I can describe probability distributions (mean, standard deviation, transformations). Questions: #11, #12	
• **Performance Task:** Students work collaboratively on an activity entitled *Are Soda Contests Real* that highlights use of simulation to assess a claim in context using *the* Essential Question: How can the context of a real-world scenario provide guidance on how to create an equation to model its probability? • Transfer Skills: Communication, Critical Thinking • Understandings: #2, 4 • Learning Targets: #2, 4	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Probability	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 3. I can determine parameters for probability distributions (geometric, binomial, normal).	**Essential Questions:** • How can an event be both random and predictable? • How can the context of a real-world scenario provide guidance on how to create an equation to model its probability?
Learning Activities: 1. Developing the probability rules through equations and simulation 2. Understanding the unpredictability of short run and the predictability of long run probabilities in context 3. Conditional probability and tests for determining if two events are independent	

4. Game of craps simulation activity.
College Board AP Statistics Course and Exam Description

Second Unit Topic: Random Variables	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 3. I can determine parameters for probability distributions (geometric, binomial, normal). 4. I can describe probability distributions (mean, standard deviation, transformations).	**Essential Questions:** ● How can the context of a real-world scenario provide guidance on how to create an equation to model its probability?
Learning Activities: 1. Discrete and continuous random variables 2. Transforming and combining random variables 3. Binomial and geometric random variables	
College Board AP Statistics Course and Exam Description	

<table>
<tr><td colspan="2">COURSE NAME: AP Statistics   Unit 5: Sampling Distributions
Est. Time: 5 weeks (8 Lessons, meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will learn that sample statistics can be used to estimate corresponding population parameters and that measures of center (mean) and variability (standard deviation) for these sampling distributions can be determined directly from the population parameters when certain sampling criteria are met. For large enough samples from any population, these sampling distributions can be approximated by a normal distribution. Simulating sampling distributions helps students to understand how the values of statistics vary in repeated random sampling from populations with known parameters.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CCSS Content Standards:
● HHS.IC.A: Understand and evaluate random processes underlying statistical experiments
● HHS.IC.B: Make inferences and justify conclusions from sample surveys, experiments, and observational studies</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends.
● CRITICAL THINKING: Analyze data in order to draw conclusions. MP#3 Construct viable arguments and critique the reasoning of others.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Given that variation may be random or not, conclusions are uncertain.
● Probabilistic reasoning allows us to anticipate patterns in data.
● The normal distribution may be used to model variation.</td><td>● What statistical measurements could be used to describe a data set?
● What patterns do I see in this data set?
● How certain are we that what seems to be a pattern is not just a coincidence?
● How likely is it to get a value (in context) this large by chance?</td></tr>
</table>

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to leverage statistical augmentation to develop an explanation or justify a conclusion using evidence from data, definitions, or statistical inference. How to use probability and simulation to explore random phenomena.	1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 3. I can determine parameters for probability distributions using the large counts condition or the central limit theorem in context. 4. I can describe probability distributions using the large counts condition or central limit theorem.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 5 Test: Sampling Distributions Unit 5 Assessment 1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. Questions: #4, #9, #10, #11, #12 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. Questions: #3, #8, #13 3. I can determine parameters for probability distributions using the large counts condition or the central limit theorem in context. Questions: #2, #5, #7, #11, #12, #13 4. I can describe probability distributions using the large counts condition or central limit theorem. Questions: #1, #5, #6, #11, #12	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)

Unit 5 Assessment	
• **Performance Task:** Students work collaboratively on an activity entitled *The German Tank Problem* that highlights use of simulation to make an inference in context using *the* Essential Question: How certain are we that what seems to be a pattern is not just a coincidence? • Transfer Skills: Communication, Critical Thinking • Understandings: #2 • Learning Targets: #2	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Introduction to Sampling Distributions	**Estimated # of Lessons: 2**
Learning Target(s): 1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context.	**Essential Questions:** • What statistical measurements could be used to describe a data set? • What patterns do I see in this data set? • How certain are we that what seems to be a pattern is not just a coincidence? • How likely is it to get a value (in context) this large by chance?
Learning Activities: 1. Conduct the German Tank Problem to establish an understanding of sampling distributions and the connection to inference to a population. 2. Determine the differences between bias and unbiased estimators through the shoe size vs foot length activity.	

College Board AP Statistics Course and Exam Description

Second Unit Topic: Sampling Distributions in Context	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can determine relative frequencies, proportions or probabilities using simulation or calculations. 2. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 3. I can determine parameters for probability distributions using the large counts condition or the central limit theorem in context. 4. I can describe probability distributions using the large counts condition or central limit theorem.	**Essential Questions:** ● What statistical measurements could be used to describe a data set? ● What patterns do I see in this data set? ● How certain are we that what seems to be a pattern is not just a coincidence? ● How likely is it to get a value (in context) this large by chance?
Learning Activities: 1. Reese's Pieces simulation activity to model sampling distributions and large counts condition for shape of the distribution. 2. Sampling distribution applet for means to highlight the Central Limit Theorem for the shape of a distribution.	
College Board AP Statistics Course and Exam Description	

COURSE NAME: AP Statistics Unit 6: Inference for Data: Categorical & Quantitative Est. Time: 7 weeks (20 Lessons, meets every other day)	
OVERVIEW *In this unit, students will be introduced to statistical inference, which will continue through the end of the course. Students will analyze categorical and quantitative data to make inferences about binomial population proportions. Provided conditions are met, students will use statistical inference to construct and interpret confidence intervals to estimate population proportions/means and perform significance tests to evaluate claims about population proportions/means. Students begin by learning inference procedures for one proportion/mean and then examine inference methods for a difference between two proportions/means. They will also interpret the two types of errors that can be made in a significance test, their probabilities, and possible consequences in context.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: ● **HHS.IC.A**: Understand and evaluate random processes underlying statistical experiments ● **HHS.IC.B**: Make inferences and justify conclusions from sample surveys, experiments, and observational studies	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. ● CRITICAL THINKING: Analyze data in order to draw conclusions. MP#3 Construct viable arguments and critique the reasoning of others.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Inference procedures are highly based on context, but the fundamentals do not change. ● Interpretation of intervals, test results and error types are equally as important to correct mathematics. ● Organization and repetitive processes are vital to success of inference procedures.	● How can we narrow the width of a confidence interval? ● How certain are we that what seems to be a pattern is not just a coincidence? ● How likely is it to get a value (in context) this large by chance? ● When can we use the normal distribution to perform inference calculations involving

	population proportions or means? ● How do we know whether to use a *z-test* vs a *t-test* for inference? ● How can we make sure that samples are independent? ● Why is it inappropriate to accept a hypothesis as true based on the results of statistical inference testing?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use the four-step process to organize, support and calculate a p-value and test score to formulate a correct conclusion. (STATE, PLAN, DO, CONCLUDE) How to leverage statistical augmentation to develop an explanation or justify a conclusion using evidence from data, definitions, or statistical inference.	1. I can identify the null and alternative hypothesis. 2. I can select and apply the correct inference method for confidence intervals or hypothesis testing based on context. 3. I can identify and check the correct conditions for inference to be met. 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 7. Justify a claim using a decision based on significance tests.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 Test: Inference for Data: Categorical & Quantitative Unit 6 Assessment 1. I can identify the null and alternative hypothesis. Questions: #2, #10 2. I can select and apply the correct inference method for confidence intervals or hypothesis testing based on context. Questions: #1, #9, #10 3. I can identify and check the correct conditions for inference to be met. Questions: #5, #6, #9, #10 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. Questions: #4, #9 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. Questions: #4, #7, #9, #10 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. Questions: #3, #8, #9, #10 Justify a claim using a decision based on significance tests. Questions: #3, #9, #10	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)
• **Performance Task:** Students work collaboratively on an activity entitled *Flint Water Crisis* that utilizes significance tests and real-world events to have students analyze data and evaluate a claim, while defending their solution using *the* Essential Question: How certain are we that what seems to be a pattern is not just a coincidence? • Transfer Skills: Communication, Critical Thinking • Understandings: #2 • Learning Targets: #1-7	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Inference for Data: Categorical	**Estimated # of Lessons: 11**
Learning Target(s): 1. I can identify the null and alternative hypothesis. 2. I can select and apply the correct inference method for confidence intervals or hypothesis testing based on context. 3. I can identify and check the correct conditions for inference to be met. 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 7. Justify a claim using a decision based on significance tests.	• How can we narrow the width of a confidence interval? • How certain are we that what seems to be a pattern is not just a coincidence? • How likely is it to get a value (in context) this large by chance? • When can we use the normal distribution to perform inference calculations involving population proportions or means? • How do we know whether to use a *z-test* vs a *t-test* for inference? • How can we make sure that samples are independent? • Why is it inappropriate to accept a hypothesis as true based on the results of statistical inference testing?

Learning Activities: 1. Conduct the beads activity having students take a sample of an unknown population to estimate the correct proportion of a color based on a sample. 2. Conduct the basketball free throw shooting simulation to begin to formulate the understanding of testing a claim. 3. Introduce and practice the 4-step process (STATE, PLAN, DO, CONCLUDE) in organize ideas and ensure a thorough response. 4. Discuss the differences between type I vs type II errors and their impacts on the context. 5. Determine and interpret the power of a test.
College Board AP Statistics Course and Exam Description

Second Unit Topic: Inference for Data: Quantitative	**Estimated # of Lessons: 10**
Learning Target(s): 1. I can identify the null and alternative hypothesis. 2. I can select and apply the correct inference method for confidence intervals or hypothesis testing based on context. 3. I can identify and check the correct conditions for inference to be met. 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 7. Justify a claim using a decision based on significance tests.	**Essential Questions:** ● How can we narrow the width of a confidence interval? ● How certain are we that what seems to be a pattern is not just a coincidence? ● How likely is it to get a value (in context) this large by chance? ● When can we use the normal distribution to perform inference calculations involving population proportions or means? ● How do we know whether to use a *z-test* vs a *t-test* for inference?

	• How can we make sure that samples are independent? • Why is it inappropriate to accept a hypothesis as true based on the results of statistical inference testing?

Learning Activities:

1. Determine the difference between z-scores and t-scores, as well as t- and z- distributions.
2. Investigate how degrees of freedom impacts t-distributions.
3. Introduce and practice the 4-step process (STATE, PLAN, DO, CONCLUDE) in organize ideas and ensure a thorough response.
4. Discuss the differences between type I vs type II errors and their impacts on the context.
5. Determine and interpret the power of a test.
6. Highlight the difference between a difference in means test and a two sample test for the difference of means.

College Board AP Statistics Course and Exam Description

COURSE NAME: AP Statistics Unit 7: Inference for Data: Chi-Square & Slopes Est. Time: 5 weeks (13 Lessons, meets every other day)	
OVERVIEW *In this unit, students will be introduced to chi-square tests, which can be used when there are two or more categories. Students need to understand how to select from the following tests: the chi-square test for goodness of fit (for a distribution of proportions of one categorical variable in a population), the chi-square test for independence (for associations between categorical variables within a single population), or the chi-square test for homogeneity (for comparing distributions of a categorical variable across populations or treatments). To integrate conceptual understanding, teachers can make connections between frequency tables, conditional probability, and calculating expected counts. The chi-square statistic is introduced to measure the distance between observed and expected counts relative to expected counts. Students will also learn how to construct confidence intervals for and perform significance tests about the slope of a population regression line when appropriate conditions are met.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CCSS Content Standards: ● **HHS.IC.A**: Understand and evaluate random processes underlying statistical experiments ● **HHS.IC.B**: Make inferences and justify conclusions from sample surveys, experiments, and observational studies	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #3: Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. ● CRITICAL THINKING: Analyze data in order to draw conclusions. MP#3 Construct viable arguments and critique the reasoning of others.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Inference procedures are highly based on context, but the fundamentals do not change. ● Interpretation of test results and error types are equally as important to correct mathematics.	● How does increasing the degrees of freedom influence the shape of a chi-squared distribution? ● How certain are we that what seems to be a pattern is not just a coincidence?

• Organization and repetitive processes are vital to success of inference procedures.	• How likely is it to get a value (in context) this large by chance? • Why do we not conclude that there is no correlation between two variables based on the results of a statistical inference of slopes? • How can we make sure that samples are independent? • Why is it inappropriate to use statistical inference to justify a claim that there is *no* association between variables?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use the four-step process to organize, support and calculate a p-value and test score to formulate a correct conclusion. (STATE, PLAN, DO, CONCLUDE) How to leverage statistical augmentation to develop an explanation or justify a conclusion using evidence from data, definitions, or statistical inference.	1. I can identify the null and alternative hypothesis. 2. I can select and apply the correct inference method based on context. 3. I can identify and check the correct conditions for inference to be met. 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 7. Justify a claim using a decision based on significance tests.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 Test: Inference for Data: Chi Square & Slopes Unit 7 Assessment 1. I can identify the null and alternative hypothesis. Questions: #1, #11, #12 2. I can select and apply the correct inference method based on context. Questions: #1, #4, #11, #12 3. I can identify and check the correct conditions for inference to be met. Questions: #2, #4, #8, #11, #12 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. Questions: #11, #12 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. Questions: #3, #5, #6, #7, #8, #11, #12 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. Questions: #8, #10, #11, #12 Justify a claim using a decision based on significance tests. Questions: #10, #11, #12	Ongoing Assessments: CollegeBoard AP Questions (Secure Documents)
• **Performance Task:** Students work collaboratively on an activity entitled *Birthday Distribution* that utilizes significance tests a to have students analyze data and evaluate a claim, while defending their solution using *the* Essential Question: How certain are we that what seems to be a pattern is not just a coincidence? • Transfer Skills: Communication, Critical Thinking • Understandings: #2 • Learning Targets: #1-7	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Inference for Data: Chi-Square	**Estimated # of Lessons: 7**
Learning Target(s): 1. I can identify the null and alternative hypothesis. 2. I can select and apply the correct inference method for confidence intervals or hypothesis testing based on context. 3. I can identify and check the correct conditions for inference to be met. 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 7. Justify a claim using a decision based on significance tests.	• How does increasing the degrees of freedom influence the shape of a chi-squared distribution? • How certain are we that what seems to be a pattern is not just a coincidence? • How likely is it to get a value (in context) this large by chance? • Why do we not conclude that there is no correlation between two variables based on the results of a statistical inference of slopes? • How can we make sure that samples are independent? • Why is it inappropriate to use statistical inference to justify a claim that there is *no* association between variables?
Learning Activities:	

1. Conduct the M&M's activity and Gummi Bear activity having students take a sample of an claimed population to determine whether there is a difference or not in the population proportion claimed based on the sample. 2. Recall and practice the 4-step process (STATE, PLAN, DO, CONCLUDE) in organize ideas and ensure a thorough response. 3. Discuss the differences between type I vs type II errors and their impacts on the context. 4. Determine the influential chi squared value for a chi square test. 5. Highlight the differences and ways to identify which chi-square test should be used using context.
College Board AP Statistics Course and Exam Description

Second Unit Topic: Inference for Data: Slopes	**Estimated # of Lessons: 6**
Learning Target(s): 1. I can identify the null and alternative hypothesis. 2. I can select and apply the correct inference method for confidence intervals or hypothesis testing based on context. 3. I can identify and check the correct conditions for inference to be met. 4. I can utilize the four-step process (STATE, PLAN, DO, CONCLUDE) to construct a complete and thorough argument in support of a particular inference. 5. I can calculate the test statistic and p-value, provided the conditions for inference are met, both with and without technology. 6. I can interpret statistical calculations and findings to assign meaning or assess a claim in context. 7. Justify a claim using a decision based on significance tests.	**Essential Questions:** • How does increasing the degrees of freedom influence the shape of a chi-squared distribution? • How certain are we that what seems to be a pattern is not just a coincidence? • How likely is it to get a value (in context) this large by chance? • Why do we not conclude that there is no correlation between two variables based on the results of a statistical inference of slopes? • How can we make sure that samples are independent?

	• Why is it inappropriate to use statistical inference to justify a claim that there is *no* association between variables?

Learning Activities:

1. Determine the difference between z-scores and t-scores, as well as t- and z- distributions.
2. Introduce the LINER method for checking the conditions for confidence intervals and hypothesis testing for the slope of a regression model.
3. Introduce and practice the 4-step process (STATE, PLAN, DO, CONCLUDE) in organize ideas and ensure a thorough response.

College Board AP Statistics Course and Exam Description

<table>
<tr><td colspan="2">COURSE NAME: Discrete Math Unit 0: Analyzing Numerical Data
Est. Time: 7 weeks (9 lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In the Analyzing Numerical Data unit students builds upon prior knowledge of ratio and focus on learning how to make decisions in everyday situations after analyzing information. Using contextual situations, students develop skills that they can apply outside the classroom.
The students develop and apply skills used in college and careers, including reasoning, planning, and communication, to make decisions and solve problems in applied situations involving numerical reasoning, statistical analysis, mathematical selection, and modeling with algebra, geometry, and trigonometry.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSG.MG.A.1: Use geometric shapes, their measures, and their properties to describe objects.
HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.
HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSF.BF.A.1.A: Determine an explicit expression, a recursive process, or steps for calculation from a context.
HSG.MG.A.2: Apply concepts of density based on area and volume in modeling situations.
HSG.MG.A.3: Apply geometric methods to solve design problems
HSA.CED.A.1: Create equations and inequalities in one variable and use them to solve problems.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #3: Construct viable arguments and critique reasoning of others.
MP #4: Model with mathematics.
MP #5: Use appropriate tools strategically.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #8: Look for and express regularity in repeated reasoning.
● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.
MP #2: Reason abstractly and quantitatively.
MP #4: Model with mathematics.
● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

• Many real world situations can be modeled and investigated using ratios and proportions.	• How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to make simplifying assumptions about real-world situations to formulate and solve hypothetical mathematical problems.	1. I can create and apply ratios and proportions to solve a variety of mathematical problems. 2. I can use aspect ratio to calculate percentage of screen used on various devices. 3. I can calculate finite combinations of items in various contexts. 4. I can calculate a weighted average.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td>Unit 0 Quiz 1:
1. I can create and apply ratios and proportions to solve a variety of mathematical problems.

Question #1
2. I can use aspect ratio to calculate percentage of screen used on various devices.

Questions #2 #3, #4, #5, #6
Unit 0 Quiz 2:
3. I can calculate finite combinations of items in various contexts.
Questions #1 #2 #3

Unit 0 Quiz 3
4. I can calculate a weighted average.

Questions #1 #2 #3</td><td>Ongoing Assessments: Various Extension Questions and Reflections in classwork documents.</td></tr>
<tr><td>● Performance Task: Students Investigate the Golden Ratio and Golden Rectangles and research how the value of the golden ratio is found. Essential Question: How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
● Transfer Skills: Critical Thinking, Self-Direction
● Understandings: #1
● Learning Targets: #1, #2</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Estimating Large Numbers</td><td>Estimated # of Classes: 5</td></tr>
<tr><td>Learning Target(s):
1. I can create and apply ratios and proportions to solve a variety of mathematical problems.
2. I can use aspect ratio to calculate percentage of screen used on various devices.</td><td>Essential Questions:
● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?</td></tr>
<tr><td colspan="2">Learning Activities:</td></tr>
</table>

1. Students use various numerical techniques to estimate large numbers in situations such as assessing the size of the crowd at a political rally. 2. Students apply proportional reasoning with ratios, rates, and percent to real-world problems involving aspect ratios in movies shown on television, tires, and other applications.
Discrete Math Unit 0

Second Unit Topic: Using Ratios	**Estimated # of Classes: 4**
Learning Target(s): 3. I can calculate finite combinations of items in various contexts. 4. I can calculate a weighted average.	Essential Questions: ● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Students calculate the number of possible telephone numbers in the United States to see when the numbers will run out. 2. Students use averages and indices as a tool for thinking about which grading system is better for a hypothetical student, and to calculate slugging percentages in baseball and NFL quarterback ratings.	
Discrete Math Unit 0	

<table>
<tr><td colspan="2">COURSE NAME: Discrete Math   Unit 1: Group Decision Making
Est. Time: 7 weeks (10 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In deciding the winner of an election, there is always one main goal: to reflect the preferences of the electorate in the fairest way possible. In this unit students will be introduced to and analyze different methods that can be used to gather group consensus. They will investigate the pros and cons of different vote counting methods and compare the outcomes of the same election using different counting methods. While the basic idea of voting is fairly universal, the method by which those votes are used to determine a winner can vary.</td></tr>
<tr><td colspan="2" align="center">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td align="center">ESTABLISHED GOALS</td><td align="center">TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling.
HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSF.BF.A.1.A: Determine an explicit expression, a recursive process, or steps for calculation from a context.
HSA.CED.A.1: Create equations and inequalities in one variable and use them to solve problems.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #4: Model with mathematics; MP #5: Use appropriate tools strategically.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #8: Look for and express regularity in repeated reasoning.
● CRITICAL THINKING: Identify a problem, ask key questions, and make predictions.
MP #2: Reason abstractly and quantitatively. MP #4: Model with mathematics.
● SELF DIRECTION: Persevere through frustration when challenging situations or temporary failures arise.
MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td align="center">UNDERSTANDINGS</td><td align="center">ESSENTIAL QUESTIONS</td></tr>
<tr><td>● There are many different formal methods that can be used to decide the outcome of an election.</td><td>● How can representing the same mathematical relationship in different ways produce conflicting outcomes?</td></tr>
</table>

• A method for determining the outcome of an election that is democratic and always fair is a mathematical impossibility.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to determine the process of sifting through the many voices of individual voters find the collective voice of the group. How to identify examples in decision making in which it is desirable to recognize voters' differences by giving them different amounts of say over the outcome of the voting.	1. I can interpret a preference schedule to determine the outcome of an election using various counting methods. 2. I can interpret a preference schedule to produce a complete or partial ranking of the candidates. 3. I can measure the power each individual voter possesses in a weighted voting system.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: 1. I can interpret a preference schedule to determine the outcome of an election using various counting methods. Unit 1 Test #1, #2, #3, #4, #5, #6 2. I can interpret a preference schedule to produce a complete or partial ranking of the candidates. Unit 1 Test #7, #8 3. I can measure the power each individual voter possesses in a weighted voting system. Unit 1 Test #9	Unit 1 Quiz 1: Unit 1 Quiz 2:

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Ballots and Preference Schedules	**Estimated # of Classes: 6**
Learning Target(s): 1. I can interpret a preference schedule to determine the outcome of an election using various counting methods. 2. I can interpret a preference schedule to produce a complete or partial ranking of the candidates.	**Essential Questions:** • How can representing the same mathematical relationship in different ways produce conflicting outcomes?
Learning Activities: 1. Students create preference schedules from a collection of preference ballots. 2. Students interpret preference schedules using a variety of counting and ranking methods.	
Excursions in Modern Mathematics (7th Edition)	

Second Unit Topic: Weighted Voting	**Estimated # of Classes: 3**

Learning Target(s):	**Essential Questions:**
3. I can measure the power each individual voter possesses in a weighted voting system.	• How can representing the same mathematical relationship in different ways produce conflicting outcomes?
Learning Activities: 1. Students use correct notation to represent a weighted voting system. 2. Students determine the power each individual voter possesses in a weighted voting system by calculation the Banzhaf Power Distribution for the system.	
Excursions in Modern Mathematics (7th Edition)	

COURSE NAME: Discrete Math Unit 2: Graphs and Networks Est. Time: 6 weeks (10 Lessons, class meets every other day)	
OVERVIEW *The Graphs and Networks unit focuses on the creation of models that represent real-world contexts involving networks and graphs and the use of these networks and graphs to investigate real-world scheduling problems. In this unit, students extend their ability to solve abstract and concrete problems. Although networks and graphs have geometrical connections (in that they are drawn in two dimensions with points, lines, and curves), the mathematical reasoning required to create, understand, and use them is new to most students.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. **HSN.Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSF.BF.A.1.A:** Determine an explicit expression, a recursive process, or steps for calculation from a context. **HSA.CED.A.1:** Create equations and inequalities in one variable and use them to solve problems.	● **COMMUNICATION**: Create a logical and evidence-based argument to support ideas. MP #4: Model with mathematics MP #5: Use appropriate tools strategically. ● **RESEARCH AND UNDERSTANDING**: Synthesize information to solve problems and defend claims. MP #8: Look for and express regularity in repeated reasoning. ● **CRITICAL THINKING**: Identify a problem, ask key questions, and make predictions. MP #2: Reason abstractly and quantitatively. MP #4: Model with mathematics. ● **SELF DIRECTION**: Persevere through frustration when challenging situations or temporary failures arise. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Graph structures can be used in determining the best methods for scheduling and completing tasks.	● How can representing the same mathematical relationship in different ways allow us to model real-world scenarios and solve problems?

• Spanning trees can represent situations and be leveraged to solve problems represented in tree diagrams.	• How can you represent physical quantities that you cannot see in the real world?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to best use graph structures to model and solve real world problems. Devise and leverage theorems and algorithms to create spanning trees and minimal spanning trees to model, investigate, and solve problems.	1. I can use algorithms to locate Euler circuits. 2. I can use theorems to determine whether graphs have Euler or Hamiltonian paths and circuits. 3. I can create graph structures to model different scenarios. 4. I can represent situations with graphs and then look at ways of determining the spanning trees that solve questions arising from the situation. 5. I can use algorithms for finding spanning trees and minimal spanning trees to solve problems.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Test 1 1. I can use algorithms to locate Euler circuits. Questions #1, #2 2. I can use theorems to determine whether graphs have Euler or Hamiltonian paths and circuits. Questions #1, #2 3. I can create graph structures to model different scenarios. Questions #1, #5 Unit 2 Test 2 4. I can represent situations with graphs and then look at ways of determining the spanning trees that solve questions arising from the situation. Questions #1, #3, #5 5. I can use algorithms for finding spanning trees and minimal spanning trees to solve problems. Questions #2, #3, #6, #7	Unit 2 Quiz 1: Unit 2 Quiz 2:
Performance Task: Students create a graph that represents the hallways in the school that need to be cleaned. They assign weights to each and design a path through the school to determine the total time it will take to clean the hallways. ● Transfer Skills: Critical Thinking, Research and Understanding, Self Direction ● Understandings: #1 ● Learning Targets: #1, #2, #3	
STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	

First Unit Topic: Euler and Hamiltonian Graphs	**Estimated # of Classes: 6**
Learning Target(s): 1. I can use algorithms to locate Euler circuits. 2. I can use theorems to determine whether graphs have Euler or Hamiltonian paths and circuits.	**Essential Questions:** ● How can representing the same mathematical relationship in different ways allow us to model

3. I can create graph structures to model different scenarios.	real-world scenarios and solve problems?

Learning Activities:

1. Students use graphs and the definitions of circuits and paths to study the Königsberg Bridge problem.
2. Students devise and use algorithms to locate Euler circuits.
3. Students make conjectures and use theorems to determine whether graphs have Euler or Hamiltonian circuits.
4. Students create graph structures to model two different scenarios.
5. Students make connections between previous graph models.
6. Students complete the entire modeling cycle: problem statement ⟶ creation of mathematical structure ⟶restatement of problem statement ⟶ mathematical solution ⟶ solution of original problem.
7. Students interpret preference schedules using a variety of counting and ranking methods.

Euler and Hamiltonian Graphs

Second Unit Topic: Networks and Spanning Trees	**Estimated # of Classes: 4**
Learning Target(s): 4. I can represent situations with graphs and then look at ways of determining the spanning trees that solve questions arising from the situation. 5. I can use algorithms for finding spanning trees and minimal spanning trees to solve problems.	**Essential Questions:** ● How can you represent physical quantities that you cannot see in the real world?

Learning Activities:

1. Students represent situations with graphs and then look at ways of determining the spanning trees that solve questions arising from the situation.
2. Students devise, test, and use algorithms for finding spanning trees and minimal spanning trees.

Networks and Spanning Trees

COURSE NAME: Math/Music Unit Title: Rhythm and Musical Notation Est. Time: 5 Weeks (10 lessons, class meets every other day)	
OVERVIEW *This unit covers the mathematics relevant to rhythm, polyrhythm, musical notes and time signature. Topics covered will include prime numbers, least common multiples, geometric and arithmetic sequences, and work with fractions.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF.IF.A.3:** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. **HSF.BF.A.1A:** Determine an explicit expression, a recursive process, or steps for calculation from a context.	CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #4: Model with mathematics. MP #6: Attend to Precision.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Geometric and arithmetic sequences can be used to analyze music. • Prime numbers and the concept of least common multiple are useful in understanding polyrhythms. • Every piece of music has mathematics in it.	• How are prime numbers and multiples related to polyrhythms? • How do geometric sequences help musicians to keep time?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
	1. I can identify arithmetic and geometric sequences and derive formulas for them

• How to identify and manipulate an arithmetic and geometric sequence using least common multiple	2. I can compute least common multiples and connect this value to certain polyrhythms 3. I can identify different types of musical notes and understand how they connect with time signatures.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1-2 Test: 1. I can identify arithmetic and geometric sequences and derive formulas for them Test questions: #6, #13 2. I can compute least common multiples and connect this value to certain polyrhythms Test questions: #3, #4, #5, #9 3. I can identify different types of musical notes and understand how they connect with time signatures. Test questions: #1, #2, #7, #8, #10-12, #14, #15-25	Pre- Assessment: Ongoing Assessments: Practice

STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	
First Unit Topic: Rhythm and Musical Notation	**Estimated # of Lessons: 8-10**
Learning Target(s): 1. I can identify arithmetic and geometric sequences and derive formulas for them 2. I can compute least common multiples and connect this value to certain polyrhythms	**Essential Questions:** • How are prime numbers and multiples related to polyrhythms? • How do geometric sequences help musicians to keep time?

3. I can identify different types of musical notes and understand how they connect with time signatures.	

Learning Activities:

1. Identifying and analyzing geometric and arithmetic sequences
2. Computing least common multiples and relating them to polyrhythms.
3. Identifying and practicing with time signatures and musical notation.

COURSE NAME: Math/Music Unit Title: The Mathematics of Sound Est. Time: 5 Weeks (8 lessons, class meets every other day)	
OVERVIEW *This unit will introduce students to the fundamental scientific and mathematical components of sound and pitch. Specific math topics include sine waves, radian measure, logarithms and exploring the relationship between frequency and pitch.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF.TF.B.5** Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline **HSF.TF.A.1** Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle **HSF.LE.A.4** For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology	CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #4: Model with mathematics. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
Understanding the mathematical rudiments of sound and pitch preclude deeper analysis and appreciation of music.	How does the Science of Sound allow for better understanding of music?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
• How to leverage the skills of trigonometry and logarithms into relationships between frequency and pitch	1. I can compute and manipulate logarithms 2. I can convert radian to degree measure in either direction

	3. I can create and interpret the graphs of sine waves 4. I can identify the relationship between frequency and pitch

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 3 Test: 1. I can compute and manipulate logarithms. Test questions: #1-4 2. I can convert radian to degree measure in either direction. Test questions: #5, 6 3. I can create and interpret the graphs of sine waves. Test questions: #7-9, #12-13, #15-16 4. I can identify the relationship between frequency and pitch. Test questions: #10-11, #14, #17-19	Pre- Assessment: N/A Ongoing Assessments: practice
Performance Task: Activity This activity allows students to explore the relationship between frequency and pitch in a hands-on manner. Essential Question: How does the Science of Sound allow for better understanding of music? Transfer Skill: Critical Thinking Understanding: #1 Learning Target: #4	

STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	
First Unit Topic: The Mathematics of Sound	**Estimated # of Lessons: 8**
Learning Target(s): 1. I can compute and manipulate logarithms 2. I can convert radian to degree measure in either direction 3. I can create and interpret the graphs of sine waves 4. I can identify the relationship between frequency and pitch	**Essential Questions:** How does the Science of Sound allow for better understanding of music?
Learning Activities: 1. Computing with logarithms. 2. Converting from degree to radian measure. 3. Creating and interpreting sine waves. 4. Relating pitch of a sound to the frequency of its wave.	

<table>
<tr><td colspan="2">COURSE NAME: Math/Music   Unit Title: Tuning Systems   Est. Time: 5 Weeks (8 lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW

Students will explore and compare three of the most prominent musical tuning systems-----Pythagorean Tuning, Just Intonation and Equal Temperament. This will necessitate understanding the relationships between frequencies and pitch in various ratios.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:

HSA.SSE.B.3.C: Use the properties of exponents to transform expressions for exponential functions.

HSN.RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents</td><td>SELF-DIRECTION: Persevere through frustration when challenging math situations arise.

MP #1: Make sense of problems and persevere in solving them.

MP#6: Attend to Precision</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>• Understanding musical tuning systems and temperaments is indispensable to gaining true knowledge of and appreciation for the relationships between math and music</td><td>• How are the three tuning systems (Pythagorean, Just Intonation and Equal Temperament) mathematically defined, and how are they both similar and different?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>• Exploring the Pythagorean, Just Intonation, Equal Temperament tuning systems.</td><td>1. I can compare musical notes and their frequencies using the Pythagorean tuning system.

2. I can compare musical notes and their frequencies using the Just Intonation tuning system.</td></tr>
</table>

	3. I can compare musical notes and their frequencies using the Equal Temperament tuning system.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 test: unit 4 test 1. I can compare musical notes and their frequencies using the Pythagorean tuning system. Test questions: #1-6, #9 2. I can compare musical notes and their frequencies using the Just Intonation tuning system. Test questions: #7, #10-14, #17 3. I can compare musical notes and their frequencies using the Equal Temperament tuning system. Test questions: #8, #15, #16, #18-19	Pre- Assessment: N/A Ongoing Assessments: practice

STAGE 3 ▯ LEARNING PLAN EXPERIENCES AND INSTRUCTION	
First Unit Topic: Tuning Systems	**Estimated # of lessons: 8**
Learning Target(s): 4. I can compare musical notes and their frequencies using the Pythagorean tuning system. 5. I can compare musical notes and their frequencies using the Just Intonation tuning system. 6. I can compare musical notes and their frequencies using the Equal Temperament tuning system.	**Essential Questions:** ● How are the three tuning systems (Pythagorean, Just Intonation and Equal Temperament) mathematically defined, and how are they both similar and different?
Learning Activities: 1. Working with the Pythagorean tuning system. 2. Working with the Just Intonation tuning system. 3. Working with the Equal Temperament tuning system.	

<table>
<tr><td colspan="2">COURSE NAME: Math/Music Unit Title: Transformations and Groups Est. Time: 5 Weeks (8 lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW

This unit covers Geometric Transformations and uses this knowledge to explore the notion of a Mathematical Group. In addition, the Golden Ratio, a mathematical constant central to mathematics, science and art, will be explored.</td></tr>
<tr><td colspan="2">STAGE 1 ⟶ IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:

HSG.CO.A.4: Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

HSN.RN.B.3: Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

HSG.SRT.A.2: Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar.</td><td>COMMUNICATION: Create a logical and evidence-based argument to support ideas.

MP #6: Attend to Precision.

CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.

MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>• Understanding the basics of Group Theory helps elucidate the role of various symmetries in music.</td><td>• How are translations, reflections, rotational symmetries and the golden ratio used to create music.</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>• Exploring how geometric transformations, symmetries and ratios impact symmetries in music.</td><td>1. I can identify and compute with geometric transformations.</td></tr>
</table>

	2. I can identify and create various symmetries. 3. I can compute with the Golden Ratio. 4. I can answer questions about groups according to their mathematical definition.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: unit 5 test 1. I can identify and compute with geometric transformations. Test questions: #3 2. I can identify and create various symmetries. Test questions: #1, #2, #4 3. I can compute with the Golden Ratio. Test questions: #5-9 4. I can answer questions about groups according to their mathematical definition. Test questions: #10-21	Pre- Assessment: N/A Ongoing Assessments: practice
Performance Task: • Students will be creating an original piece of music that incorporates some of the ideas/concepts covered in the course. Essential Question: How are translations, reflections, rotational symmetries and the golden ratio used to create music Transfer Skill: Communication Understanding: #1 Learning Target: #2	

STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	
First Unit Topic: Transformations and Groups	**Estimated # of Lessons: 8**
Learning Target(s): 1. I can identify and compute with geometric transformations. 2. I can identify and create various symmetries. 3. I can compute with the Golden Ratio. 4. I can answer questions about groups according to their mathematical definition.	**Essential Questions:** • How are translations, reflections, rotational symmetries and the golden ratio used to create music.
Learning Activities: 1. Working with geometric transformations. 2. Identifying and analyzing symmetries. 3. Computing with the golden ratio. 4. Defining and understanding the concept of a mathematical group.	

COURSE NAME: Math and Art: Exploring the Connections	
Grade Level / Prerequisites: *Successful completion of Algebra 1. No prior artistic knowledge is necessary.* **Duration (Semester/Year):** *Semester* **Number of Units:** *5* **Course Credit:** *1/2 credit*	**OVERVIEW** This course will explore various examples of how mathematics and art are closely connected. In particular, pertinent mathematical theorems and problems, vocabulary and concepts, and artistic samples (paintings, sculpture, architecture, etc…)

<table>
<tr><td colspan="2">COURSE NAME: Math/Art Unit Title: The Golden Ratio Est. Time: 4 Weeks (8 lessons)</td></tr>
<tr><td colspan="2">OVERVIEW

What do sunflowers, the Parthenon and the human body have in common?
In this unit students will gain a mathematical understanding of the golden ratio and its application in various works of art and other forms.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:

HSG.SRT.A.2: Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar.

HSG.SRT.A.3: Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

HSN.RN.B.3: Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.</td><td>CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.

MP #6: Attend to precision.
MP #2: Reason abstractly and quantitatively.

COMMUNICATION: Create a logical and evidence-based argument to support ideas.

MP #1: Make sense of problems and persevere in solving them.

MP #4: Model with mathematics.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>The golden ratio is always a mathematical approximation.</td><td>How are mathematical concepts incorporated into works of art?</td></tr>
</table>

• Objects that incorporate the golden ratio tend to be more visually appealing to human eye. • Every visual creation has geometry in it.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
• How to use the mathematical concepts of ratio, proportion and geometric similarity to solve problems about a piece of art.	1. I can compute with the golden ratio (an irrational number) and can perform basic math computations with it. 2. I can determine if the golden ratio is incorporated in some piece of art or other form. 3. I can use the concepts of ratio, proportion and geometric similarity to create art.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Summative Quizzes • To be added	
1. I can identify an irrational number vs. a rational number. 2. I can determine if the golden ratio is incorporated in some piece of art. 3. I can use the concepts of ratio, proportion and geometric similarity to solve problems related to art.	Pre- Assessment: N/A Ongoing Assessments: • To be added
Performance Task: • To be added	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION

First Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**
Learning Activities:	

Second Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**
Learning Activities:	

<table>
<tr><td colspan="2">COURSE NAME: Math/Art Unit Title: Plane Transformations Est. Time: 4 Weeks (8 lessons)</td></tr>
<tr><td colspan="2">OVERVIEW
Did you know that looking in the mirror can be an artistic experience?
In this unit students will explore symmetry and geometric transformations and how they are useful in understanding and creating art.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:

HSA.CO.A.2: Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as output

HSA.CO.A.4: Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments

HAS.CO.A.5: Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.</td><td>CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.

MP #6: Attend to precision.

MP #2: Reason abstractly and quantitatively.

COMMUNICATION: Create a logical and evidence-based argument to support ideas.

MP #1: Make sense of problems and persevere in solving them.

MP #4: Model with mathematics.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>• Geometric transformations come in all shapes, sizes and patterns.

• Objects that incorporate symmetry tend to be more visually appealing to human eye.</td><td>• How are mathematical concepts incorporated into works of art?</td></tr>
</table>

• Every visual creation has geometry in it.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
• How to identify geometric transformations that are incorporated into works of art.	1. I can transform polygons or other figures geometrically in various ways. 2. I can identify and categorize types of symmetry incorporated into art. 3. I can use symmetry and geometric transformations to create a piece of art.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Summative Quizzes • To be added	
1. I can transform polygons or other figures geometrically in various ways. 2. I can analyze a piece of art in terms of geometric transformations. 3. I can identify and categorize types of symmetry incorporated into art.	Pre- Assessment: N/A Ongoing Assessments: • To be added
Performance Task: • To be added	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**

Learning Activities:	

Second Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**
Learning Activities:	

<table>
<tr><td colspan="2">COURSE NAME: Math/Art   Unit Title: 3-dimensional objects
Est. Time: 4 Weeks (8 lessons)</td></tr>
<tr><td colspan="2">OVERVIEW

Did you know that Bugs Bunny has geometry in him?
In this unit students will explore the 5 Platonic Solids and other 3-dimensional figures will be explored.
In addition, the concept of perspective will be studied.</td></tr>
<tr><td colspan="2">STAGE 1 ⟶ IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:

HSG.GMD.B.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

HSG.MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

HSG.SRT.A.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar.</td><td>CRITICAL THINKING: Demonstrate flexibility and determination when solving problems.

MP #6: Attend to precision.

MP #2: Reason abstractly and quantitatively.

COMMUNICATION: Create a logical and evidence-based argument to support ideas.

MP #1: Make sense of problems and persevere in solving them.

MP #4: Model with mathematics.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Artistic perspective is a useful tool for making cartoons and other works of art.</td><td>● How are mathematical concepts incorporated into works of art?</td></tr>
</table>

• The geometry of polyhedra is useful in appreciating many works of art. • Every visual creation has geometry in it.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
• How to identify Platonic solids and *perspective* to better understand a work of art.	1. I can identify the Platonic solids and their properties. 2. I can use mathematics to analyze a work of art that incorporates *perspective*. 3. I can use *perspective* to create a work of art.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Summative Quizzes • To be added	
1. I can identify the Platonic solids and their properties. 2. I can use mathematics to analyze a work of art that incorporates *perspective*.	Pre- Assessment: N/A Ongoing Assessments: • To be added
STAGE 3 LEARNING PLAN EXPERIENCES AND INSTRUCTION	
Performance Task: • To be added	

First Unit Topic: N/A	**Estimated # of Lessons:**	
Learning Target(s):	**Essential Questions:**	

Learning Activities:		

Second Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**
Learning Activities:	

COURSE NAME: Math/Art Unit Title: The Circle, the Sphere and the Conic Sections Est. Time: 4 Weeks (8 lessons)	
OVERVIEW *How can an ice cream be considered art?* *In this unit of study students will explore the many geometric properties of circles, spheres and conic sections, as well as studying how they can be incorporated into works of art.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG.GPE.A.1** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. **HSG.GPE.A.3** Derive the equation of a parabola given a focus and directrix. **HSG.C.A.2** Identify and describe relationships among inscribed angles, radii, and chords. **HSG.C.A.4** Construct a tangent line from a point outside a given circle to the circle.	CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #6: Attend to precision. MP #2: Reason abstractly and quantitatively. COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Understanding the geometry of circles, spheres and conic sections can foster a	• How are mathematical concepts incorporated into works of art?

better appreciation for certain works of art. • Every visual creation has geometry in it.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
• How to write the equations and compute measurements for circles, spheres and conic sections.	1. I can create and interpret equations for circles and conic sections. 2. I can determine various measurements on circles and spheres. 3. I can use circles, spheres and conic sections to creat a work of art.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Summative Quizzes • To be added	
1.	Pre- Assessment: N/A Ongoing Assessments: • To be added
Performance Task: • To be added	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**

Learning Activities:	

Second Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**
Learning Activities:	

COURSE NAME: Math/Art Unit Title: Fractals Est. Time: 4 Weeks (8 lessons)	
OVERVIEW *Can a tree be considered a work of art?* *In this unit of study students will be exposed to the Mathematics of Fractals and the concepts of self-similarity, iteration and non-integer dimensions.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG.MG.A.1** Use geometric shapes, their measures, and their properties to describe objects. **HSF.BF.A.1** Determine an explicit expression, a recursive process, or steps for calculation from a context. **HSF.BF.B.3** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative).	CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #6: Attend to precision. MP #2: Reason abstractly and quantitatively. COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Fractals and the concept of self-similarity can be used to generate a variety of artistic designs.	• How are mathematical concepts incorporated into works of art?

• Every visual creation has geometry in it.	
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
• How to create a fractal design either by hand or using technology.	1. I can use iterative functions to describe a fractal design. 2. I can compute the dimension of a given fractal. 3. I can use self-similarity to create a work of art.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Summative Quizzes • To be added	
1.	Pre- Assessment: N/A Ongoing Assessments: • To be added
Performance Task: • To be added	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: N/A	**Estimated # of Lessons:**
Learning Target(s):	**Essential Questions:**
Learning Activities:	

Second Unit Topic: N/A	Estimated # of Lessons:
Learning Target(s):	**Essential Questions:**
Learning Activities:	

COURSE NAME: Plane Geometry-A	
Grade Level / Prerequisites: *Successful completion of Algebra 1A/Link.* **Duration (Semester/Year):** *Semester* **Number of Units:** *4* **Course Credit:** *1/2 credit*	**OVERVIEW** This half year Geometry course will focus on the concepts of similarity, trigonometry, and circles. These topics are the ones most likely to be found on the SAT.

COURSE NAME: Geometry **First Unit - Geometry IM Unit 3: Similarity** **Est. Time: 8 Weeks (16 Lessons, class meets every other day)**	
OVERVIEW *In this unit, students use dilations and rigid transformations to justify triangle similarity theorems including the Angle-Angle Triangle Similarity Theorem. Students build on their work with congruence and rigid motions, establishing that triangles are similar by dilating them strategically. Additionally, students work more with proofs as well as finding missing side lengths and angle measurements.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-SRT.A:** Understanding similarity in terms of similarity transformations **HSG-SRT.B:** Prove theorems involving similarity	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Dilations are transformations based on scale factors and center where corresponding sides are proportional and angles preserve measure ● Scaled models that hold proportionality can be used to find heights and lengths of large objects in the real-world	● What is the relationship between a figure and its scaled image? ● How can we use similarity to solve real-world problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use dilations and scale factors to prove similarity in triangles	1. I can explain what happens to lines and angles in a dilation 2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally

How to use properties of right triangles to determine triangle similarity	3. I can find scale factors and use them to solve problems 4. I can calculate the lengths of parts of a scaled drawing 5. I can dilate a figure given a scale factor and center 6. I can critique proofs that use similarity 7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle

<table>
<tr><th colspan="2">STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 3 End of Unit Assessment: Similarity
Geometry-3-End-of-Unit-Assessment-teacher-guide.docx

1. I can explain what happens to lines and angles in a dilation
TEST Question: #1

2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally
TEST Questions: #2

3. I can find scale factors and use them to solve problems
TEST Question: #3

4. I can calculate the lengths of parts of a scaled drawing
TEST Questions: #4

5. I can dilate a figure given a scale factor and center
TEST Questions: #5

6. I can critique proofs that use similarity
TEST Questions: #6

7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle
TEST Questions: #7</td><td>Pre- Assessment:
Geometry-3-Check-Your-Readiness-teacher-guide

Check Your Readiness assessment

Ongoing assessment:
Unit 3 Cool Downs

Unit 3 quizzes</td></tr>
<tr><td>• Performance Task: The height of a school building is unknown. Given their height, their distance to the mirror, and the distance from the mirror to the building, students must use similarity in order to answer the Essential Question: how can we use similarity to solve real-world problems?
• Transfer Skills: Communication and Critical Thinking
• Understandings: #1
• Learning Targets: #1, #3, #4</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Dilations and Proportional Reasoning</td><td>Estimated # of Lessons: 12</td></tr>
<tr><td>Learning Target(s):
1. I can explain what happens to lines and angles in a dilation</td><td>Essential Questions:</td></tr>
</table>

2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally 3. I can find scale factors and use them to solve problems 4. I can calculate the lengths of parts of a scaled drawing 5. I can dilate a figure given a scale factor and center 6. I can critique proofs that use similarity	• What is the relationship between a figure and its scaled image?
Learning Activities: 1. Perform dilations given a center and scale factor. 2. Find ratios of corresponding lengths after a dilation. 3. Use dilations to write proofs about parallel lines. 4. Determine if figures are similar by definition. 5. Disprove and prove statements about similar figures. 6. Determine if figures are similar by Angle-Angle, Side-Side-Side, and Side-Angle-Side	
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Second Unit Topic: Similarity in Right Triangles	**Estimated # of Lessons: 4**
Learning Target(s): 7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle	**Essential Questions:** • How can we use similarity to solve real-world problems?
Learning Activities: 1. Use Pythagorean Theorem to find missing side lengths in right triangles 2. Prove Pythagorean Theorem 3. Use triangle similarity properties to find unknown measurements in triangles 4. Calculate the angle required to make a bunker shot in billiards scenario	
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COURSE NAME: Geometry Second Unit - Geometry IM Unit 4: Right Triangle Trigonometry **Est. Time: 6 Weeks (11 Lessons, class meets every other day)**	
OVERVIEW *In this unit, students build an understanding of ratios in right triangles which leads to naming cosine, sine, and tangent as trigonometric ratios. Practicing without naming the ratios allows students to connect similarity, proportional reasoning, and scale factors to right triangles with a specific acute angle. Students encounter several contexts to both make sense of and apply right triangle measurement.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-SRT.C:** Define trigonometric ratios and solve problems involving right triangles.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Ratios of sides in any sized right triangle are consistent and can be named which allows us to utilize them in any context to find missing lengths and angle measures	• How can trigonometric ratios allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to identify, name, and use trigonometric ratios to find missing measurements in right triangles	1. I can determine the side lengths of triangles with 30, 60, and 90 degree angles 2. I can build a table of ratios of side lengths of right triangles 3. I can use trigonometry to solve problems

	4. I can use cosine, sine, and tangent to find side lengths of right triangles 5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 4 End of Unit Assessment: Right Triangle Trigonometry
Geometry-4-End-of-Unit-Assessment-teacher-guide.docx

1. I can determine the side lengths of triangles with 30, 60, and 90 degree angles
TEST Question: #1

2. I can build a table of ratios of side lengths of right triangles
TEST Questions: #2

3. I can use trigonometry to solve problems
TEST Question: #3, #6, #7

4. I can use cosine, sine, and tangent to find side lengths of right triangles
TEST Questions: #4

5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle
TEST Questions: #5</td><td>Pre- Assessment: Geometry-4-Check-Your-Readiness-teacher-guide

Check Your Readiness assessment

Ongoing assessment: Unit 4 Cool Downs

Unit 4 quizzes</td></tr>
<tr><td>● Performance Task: Given a regular n-sided polygon of radius 1, students must partition the polygon into “n” triangles to find the perimeter and approximate pi in order to answer the Essential Question: How can trigonometric ratios allow us to model real-world scenarios and solve problems?
● Transfer Skills: Communication and Critical Thinking
● Understandings: #1
● Learning Targets: #3, #4</td><td></td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Relationships in Right Triangles & Trigonometric Ratios	**Estimated # of Lessons: 11**
Learning Target(s):	**Essential Questions:**

1. I can determine the side lengths of triangles with 30-, 60-, and 90-degree angles 2. I can build a table of ratios of side lengths of right triangles 3. I can use trigonometry to solve problems 4. I can use cosine, sine, and tangent to find side lengths of right triangles 5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle	• How can trigonometric ratios allow us to model real-world scenarios and solve problems?
Learning Activities: 1. Find lengths of special right triangles. 2. Create a trigonometric ratio table. 3. Use trigonometric ratios to find side lengths of right triangles. 4. Relate sine and cosine ratios of complementary angles. 5. Using inverse trigonometric ratios to find missing angles of right triangles. 6. Use trigonometry to solve real world problems.	
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COURSE NAME: Geometry	Third Unit - Geometry IM Unit 7: Circles
Est. Time: 6 Weeks (14 Lessons, class meets every other day)	
OVERVIEW *In this unit, students analyze relationships between segments and angles in circles, leading to the construction of inscribed and circumscribed circles of triangles. Students solve problems involving arc length and sector area, and they use the similarity of all circles and ideas of arc length to develop the concept of radian measure for angles.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-C.A:** Understand and apply theorems about circles **HSG-C.B:** Find arc length and area of sectors of circles	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● There exists a relationship between different parts of a circle that can be used to find missing measurements and solve problems	● How do parts of a circle relate to each other in order to solve real-world problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to utilize knowledge of central angles and inscribed figures to find missing angle measures	1. I can use the relationship between central and inscribed angles to calculate angle measures 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles 3. I can construct a circumscribed circle of a triangle

How to calculate measurements of arc length and sector area when given specific information about a circle	4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems 5. I can demonstrate that when a circle is dilated, some ratios stay constant 6. I can calculate lengths of arcs and areas of sectors in circles 7. I can calculate the area of a sector whose central angle measure is given in radians

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 End of Unit Assessment: Circles Geometry-7-End-of-Unit-Assessment-teacher-guide (1).docx 1. I can use the relationship between central and inscribed angles to calculate angle measures TEST Question: #1 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles TEST Questions: #2 3. I can construct a circumscribed circle of a triangle TEST Questions: #4 4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems TEST Question: #5 5. I can demonstrate that when a circle is dilated, some ratios stay constant TEST Questions: #3 6. I can calculate lengths of arcs and areas of sectors in circles TEST Questions: #6 7. I can calculate the area of a sector whose central angle measure is given in radians TEST Questions: #7	Pre- Assessment: Geometry-7-Check-Your-Readiness-teacher-guide Check Your Readiness assessment Ongoing assessment: Unit 7 Cool Downs Unit 7 quizzes
• **Performance Task**: Given the diameter of a pizza and the price per slice from four different pizza vendors, students must decide which vendor offers the best deal in order to answer the Essential Question: How do parts of a circle relate to each other in order to solve real-world problems? • Transfer Skills: Communication and Critical Thinking • Understandings: #2 • Learning Targets: #6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Lines, Angles, and Polygons within Circles	**Estimated # of Lessons: 7**
Learning Target(s): 1. I can use the relationship between central and inscribed angles to calculate angle measures 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles 3. I can construct a circumscribed circle of a triangle 4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems	**Essential Questions:** How do parts of a circle relate to each other in order to solve real-world problems?
Learning Activities: 1. Define and identify parts of a circle. 2. Calculate and use inscribed angles to solve problems. 3. Define tangent lines and use them to solve problems. 4. Construct and draw conclusions of inscribed and circumscribed quadrilaterals. 5. Construct and draw conclusions of inscribed/ circumscribed triangles and circumcenters/ incenters.	
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Second Unit Topic: Measuring Circles	**Estimated # of Lessons: 7**
Learning Target(s): 5. I can demonstrate that when a circle is dilated, some ratios stay constant 6. I can calculate lengths of arcs and areas of sectors in circles 7. I can calculate the area of a sector whose central angle measure is given in radians	**Essential Questions:** How do parts of a circle relate to each other in order to solve real-world problems?

Learning Activities: 1. Calculate areas of sectors and measures of arc lengths 2. Work backward from given central angle measure to find area, radius, and circumference 3. Define radians by observing relationships between radius and arc length 4. Justify the formula for area of a sector in radians
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COURSE NAME: Geometry First unit: Geometry IM1: Constructions and Rigid Transformations Est. Time: 8 Weeks (22 Lessons, class meets every other day)	
OVERVIEW *In this unit, students will explore geometric properties using straightedge and compass constructions. This will lead to making observations before defining terms such as rotations, reflections, and translations. Students will then use formal definitions they developed to prove statements involving angles and distances, leading to work on proofs in the next unit.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-CO.A:** Experiment with transformations in the plane **HSG-CO.C**: Prove geometric theorems **HSG-CO.D:** Make geometric constructions	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #7: Look for and make use of structure.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• The properties of a shape do not change when it is reflected, rotated, or translated. • Making a geometric argument requires referencing definitions and facts.	• How do we construct rigid transformations (rotations, reflections, and translations), and how do they help us create arguments?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use formal definitions to make constructions	1. I can use formal definitions to write arguments about geometric figures. 2. I can follow instructions to create a construction. 3. I can construct a perpendicular bisector and understand what is special about points that are equidistant from two given points

How to identify and utilize rigid transformations to build new observations and construct arguments	4. I can identify congruent segments in figures and explain why they are congruent 5. I can describe the rotations that take a figure onto itself. 6. I can describe a sequence of transformations that takes given points to another set of points. 7. I can label and make conjectures from diagrams. 8. I can prove the angles in a triangle sum to 180 degrees.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Mid-Assessment: Constructions Geometry Unit 1 Mid-Assessment 1. I can understand formal definitions of geometric figures TEST Question: #4 2. I can follow instructions to create a construction TEST Questions: #3, #6 3. I can construct a perpendicular bisector and understand what is special about points that are equidistant from two given points TEST Question: #2, #5 4. I can identify congruent segments in figures and explain why they are congruent TEST Questions: #1, #7 Unit 1 End of Unit Assessment: Rigid Transformations Geometry-1-End-of-Unit-Assessment-teacher-guide (1).docx 5. I can describe the rotations that take a figure onto itself TEST Questions: #1 6. I can describe a sequence of transformations that takes given points to another set of points TEST Questions: #2, #3, #4, #6 7. I can label and make conjectures from diagrams TEST Questions: #5, #7 8. I can prove the angles in a triangle sum to 180 degrees TEST Questions: #7	Pre- Assessment: Geometry-1-Check-Your-Readiness-teacher-guide.docx Geometry-1-Check-Your-Readiness-assessment.pdf Ongoing Assessments: Unit 1 Cool Downs Unit 1 Quizzes
• **Performance Task**: Given a design, students will record rigid transformations, reconstruct the design, and record instructions on how to construct the design in order to answer the Essential Question: How do we construct rigid transformations (rotations, reflections, and translations), and how do they help us create arguments? • Transfer Skills: Communication and Critical Thinking • Understandings: #1, #2 • Learning Targets: #1, #2, #4, #6, #7	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Constructions	**Estimated # of Lessons: 9**
• I can understand formal definitions of geometric figures • I can follow instructions to create a construction • I can construct a perpendicular bisector and understand what is special about points that are equidistant from two given points • I can identify congruent segments in figures and explain why they are congruent	**Essential Questions:** How do we construct rigid transformations (rotations, reflections, and translations), and how do they help us create arguments?
Learning Activities: 1. Use online construction tools and write instructions to create geometric figures. 2. Construct parallel and perpendicular lines. 3. Construct perpendicular bisectors and angle bisectors. 4. Construct perpendicular lines through a given point. 5. Construct geometric shapes (equilateral triangles, squares, and hexagons)	
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Second Unit Topic: Rigid Transformations & Evidence and Proof	**Estimated # of Lessons: 13**
Learning Target(s): • I can describe the rotations that take a figure onto itself. • I can describe a sequence of transformations that takes given points to another set of points. • I can label and make conjectures from diagrams. • I can prove the angles in a triangle sum to 180 degrees.	**Essential Questions:** How do we construct rigid transformations (rotations, reflections, and translations), and how do they help us create arguments?
Learning Activities:	

1. Identify, describe, and construct sequences of rigid transformations 2. Identifying figures with line/rotational symmetry 3. Identify congruent and supplementary angles to find missing angles 4. Prove theorems based on a set of parallel lines with a transversal
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<table>
<tr><td colspan="2">COURSE NAME: Geometry Second Unit: Geometry IM2: Congruence
Est. Time: 5 Weeks (15 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students use transformations as a tool for reasoning about the relationship between congruent parts of figures and congruent figures. Students utilize transformations to prove three theorems about triangle congruence: Side-Angle-Side congruence, Angle-Side-Angle congruence, and Side-Side-Side congruence. Students then apply these theorems to other figures, including equilateral triangles and quadrilaterals.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSG-CO.A: Experiment with transformations in the plane
HSG-CO.B: Understanding congruence in terms of rigid motions.
HSG-CO.C: Prove geometric theorems.
HSG-CO.D: Make geometric constructions.</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision.

MP #7 Look for and make use of structure
● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Rigid transformations preserve size and shape and therefore create figures that are exactly the same.

● Making a geometric argument requires referencing definitions and facts.</td><td>● What does it mean for figures to be congruent?

● How do we justify figures are congruent?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>How to use rigid transformations to prove congruence</td><td>1. I can apply theorems about triangles to find missing angles

2. I can use rigid transformations to figure out if figures are congruent

3. I can use rigid transformations to explain why figures are congruent</td></tr>
</table>

How to write and apply triangle congruence theorems	4. I can write a proof that segments of the same length are congruent 5. I can use Side-Angle-Side Triangle Congruence Theorem in a proof 6. I can prove theorems about the diagonals of a parallelogram

<table>
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<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 2 End of Unit Assessment: Congruence
Geometry-2-End-of-Unit-Assessment-teacher-guide (1).docx
1. I can apply theorems about triangles to find missing angles
TEST Question: #5, #6

2. I can use rigid transformations to figure out if figures are congruent
TEST Questions: #2

3. I can use rigid transformations to explain why figures are congruent
TEST Question: #3

4. I can write a proof that segments of the same length are congruent
TEST Questions: #7

5. I can use Side-Angle-Side Triangle Congruence Theorem in a proof
TEST Questions: #1

6. I can prove theorems about the diagonals of a parallelogram
TEST Questions: #4</td><td>Pre- Assessment:
Geometry
Unit 2
Check-Your-Readiness-teacher-guide.docx

Geometry
Unit 2
Check-Your-Readiness-assessment.pdf

Ongoing Assessments:
Unit 2 Cool Downs

Unit 2 Quizzes</td></tr>
<tr><td>Performance Task: Given criteria of two parallelograms, students must decide if they are congruent. In addition, students then must create another criterion that is enough to be sure two parallelograms are congruent in order to answer the Essential Question: how do we justify figures are congruent?

● Transfer Skills: Communication and Critical Thinking
● Understandings: #1
● Learning Targets: #1, #5, #6</td><td></td></tr>
</table>

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Proving Congruence by Rigid Transformations	**Estimated # of Lessons: 9**

Learning Targets:	**Essential Questions:**
1. I can apply theorems about triangles to find missing angles 2. I can use rigid transformations to figure out if figures are congruent 3. I can use rigid transformations to explain why figures are congruent 4. I can write a proof that segments of the same length are congruent	• What does it mean for figures to be congruent?
Learning Activities: 1. Create quadrilaterals from triangles and a series of rigid transformations 2. Identify congruent figures 3. Prove triangle congruence theorems (SAS, ASA, SSS) 4. Find missing angle measures from a set of parallel lines and transversal	
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Second Unit Topic: Triangle Congruence Theorems	**Estimated # of Lessons: 6**
Learning Target(s): 5. I can use Side-Angle-Side Triangle Congruence Theorem in a proof 6. I can prove theorems about the diagonals of a parallelogram	**Essential Questions:** • How do we justify figures are congruent?
Learning Activities: 1. Justify triangle congruence by using theorems 2. Create a proof from a given conjecture 3. Prove that diagonals of a parallelogram bisect each other	
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COURSE NAME: Geometry **Third Unit: Geometry IM3: Similarity** **Est. Time: 5 Weeks (16 Lessons, class meets every other day)**	
OVERVIEW *In this unit, students use dilations and rigid transformations to justify triangle similarity theorems including the Angle-Angle Triangle Similarity Theorem. Students build on their work with congruence and rigid motions, establishing that triangles are similar by dilating them strategically. Additionally, students work more with proofs as well as finding missing side lengths and angle measurements.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-SRT.A:** Understanding similarity in terms of similarity transformations **HSG-SRT.B:** Prove theorems involving similarity	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Dilations are transformations based on scale factors and center where corresponding sides are proportional and angles preserve measure ● Scaled models that hold proportionality can be used to find heights and lengths of large objects in the real-world	● What is the relationship between a figure and its scaled image? ● How can we use similarity to solve real-world problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to use dilations and scale factors to prove similarity in triangles	1. I can explain what happens to lines and angles in a dilation 2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally

How to use properties of right triangles to determine triangle similarity	3. I can find scale factors and use them to solve problems 4. I can calculate the lengths of parts of a scaled drawing 5. I can dilate a figure given a scale factor and center 6. I can critique proofs that use similarity 7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle

<table>
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<tr><td>Unit 3 End of Unit Assessment: Similarity
Geometry-3-End-of-Unit-Assessment-teacher-guide.docx

1. I can explain what happens to lines and angles in a dilation
TEST Question: #1

2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally
TEST Questions: #2

3. I can find scale factors and use them to solve problems
TEST Question: #3

4. I can calculate the lengths of parts of a scaled drawing
TEST Questions: #4

5. I can dilate a figure given a scale factor and center
TEST Questions: #5

6. I can critique proofs that use similarity
TEST Questions: #6

7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle
TEST Questions: #7</td><td>Pre- Assessment:
Geometry-3-Check-Your-Readiness-teacher-guide.docx

Ongoing Assessments:
Unit 3 Cool Downs

Unit 3 Quizzes</td></tr>
<tr><td>• Performance Task: The height of a school building is unknown. Given their height, their distance to the mirror, and the distance from the mirror to the building, students must use similarity in order to answer the Essential Question: how can we use similarity to solve real-world problems?
• Transfer Skills: Communication and Critical Thinking
• Understandings: #1
• Learning Targets: #1, #3, #4</td><td></td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Dilations and Proportional Reasoning	**Estimated # of Lessons: 12**

Learning Target(s):	**Essential Questions:**
1. I can explain what happens to lines and angles in a dilation 2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally 3. I can find scale factors and use them to solve problems 4. I can calculate the lengths of parts of a scaled drawing 5. I can dilate a figure given a scale factor and center 6. I can critique proofs that use similarity	• What is the relationship between a figure and its scaled image?
Learning Activities: 1. Perform dilations given a center and scale factor. 2. Find ratios of corresponding lengths after a dilation. 3. Use dilations to write proofs about parallel lines. 4. Determine if figures are similar by definition. 5. Disprove and prove statements about similar figures. 6. Determine if figures are similar by Angle-Angle, Side-Side-Side, and Side-Angle-Side	
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Second Unit Topic: Similarity in Right Triangles	**Estimated # of Lessons: 4**
Learning Target(s): 7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle	**Essential Questions:** • How can we use similarity to solve real-world problems?
Learning Activities: 1. Use Pythagorean Theorem to find missing side lengths in right triangles 2. Prove Pythagorean Theorem 3. Use triangle similarity properties to find unknown measurements in triangles 4. Calculate the angle required to make a bunker shot in billiards scenario	
https://im.kendallhunt.com	

COURSE NAME: Geometry Fourth Unit: Geometry IM4: Right Triangle Trigonometry Est. Time: 5 Weeks (11 Lessons, class meets every other day)	
OVERVIEW *In this unit, students build an understanding of ratios in right triangles which leads to naming cosine, sine, and tangent as trigonometric ratios. Practicing without naming the ratios allows students to connect similarity, proportional reasoning, and scale factors to right triangles with a specific acute angle. Students encounter several contexts to both make sense of and apply right triangle measurement.*	
STAGE 1 ⟶ IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-SRT.C:** Define trigonometric ratios and solve problems involving right triangles.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Ratios of sides in any sized right triangle are consistent and can be named which allows us to utilize them in any context to find missing lengths and angle measures	● How can trigonometric ratios allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to identify, name, and use trigonometric ratios to find missing measurements in right triangles	1. I can determine the side lengths of triangles with 30, 60, and 90 degree angles 2. I can build a table of ratios of side lengths of right triangles 3. I can use trigonometry to solve problems

	4. I can use cosine, sine, and tangent to find side lengths of right triangles 5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle

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<tr><td>Unit 4 End of Unit Assessment: Right Triangle Trigonometry
Geometry-4-End-of-Unit-Assessment-teacher-guide.docx

1. I can determine the side lengths of triangles with 30, 60, and 90 degree angles
TEST Question: #1

2. I can build a table of ratios of side lengths of right triangles
TEST Questions: #2

3. I can use trigonometry to solve problems
TEST Question: #3, #6, #7

4. I can use cosine, sine, and tangent to find side lengths of right triangles
TEST Questions: #4

5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle
TEST Questions: #5</td><td>Pre- Assessment:
Geometry-4-Check-Your-Readiness-teacher-guide.docx

Ongoing Assessments:
Unit 4 Cool Down

Unit 4 Quizzes</td></tr>
<tr><td>● Performance Task: Given a regular n-sided polygon of radius 1, students must partition the polygon into “n” triangles to find the perimeter and approximate pi in order to answer the Essential Question: How can trigonometric ratios allow us to model real-world scenarios and solve problems?
● Transfer Skills: Communication and Critical Thinking
● Understandings: #1
● Learning Targets: #3, #4</td><td></td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Relationships in Right Triangles & Trigonometric Ratios	**Estimated # of Lessons: 11**
Learning Target(s):	**Essential Questions:**

<table>
<tr>
<td>

I can determine the side lengths of triangles with 30-, 60-, and 90-degree angles
I can build a table of ratios of side lengths of right triangles
I can use trigonometry to solve problems
I can use cosine, sine, and tangent to find side lengths of right triangles
I can explain why the sine of an angle is equal to the cosine of 90 minus that angle

</td>
<td>

How can trigonometric ratios allow us to model real-world scenarios and solve problems?

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<tr>
<td colspan="2">
Learning Activities:

Find lengths of special right triangles.
Create trigonometric ratio table.
Use trigonometric ratios to find side lengths of right triangles.
Relate sine and cosine ratios of complementary angles.
Using inverse trigonometric ratios to find missing angles of right triangles.
Use trigonometry to solve real world problems.

</td>
</tr>
<tr>
<td colspan="2">https://im.kendallhunt.com</td>
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</table>

<table>
<tr><td colspan="2">COURSE NAME: Geometry Fifth Unit: Geometry IM6: Solid Geometry
Est. Time: 5 Weeks (18 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students practice spatial visualization in three dimensions, study the effect of dilation on area and volume, derive formulas using dissection arguments, and apply volume formulas to solve problems involving surface area, density, cube roots, and square roots.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSG-GMD.A: Explain volume formulas and use them to solve problems
HSG-GMD.B: Visualize relationships between two-dimensional and three-dimensional objects
HSG-MG.A: Apply geometric concepts in modeling situations
HSN-Q.A: Reason quantitatively and use units to solve problems</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision.

MP #7 Look for and make use of structure
● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Based on a scale factor k, the area of a scaled image is the original area times k^2 and the volume of the scaled image is the original volume times k^3

● Visualizing the relationships between two-dimensional and three-dimensional figures with the use of technology allows for an increased understanding of properties of three-dimensional solids</td><td>● How does scaling two-dimensional and three-dimensional objects affect area and volume?

● How do you extend what you know about two dimensional shapes to three dimensional solids?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td></td><td></td></tr>
</table>

How to visualize the relationship between two-dimensional figures and three-dimensional solids How to create a relationship between scale factors and changes to area and volume How to calculate volume and density of three-dimensional solids using formulas	1. I can identify the three-dimensional solid created by rotating a two-dimensional figure using a linear axis 2. I know that when a solid is dilated by a scale factor of k, its surface area is multiplied by k^2 and its volume is multiplied by k^3 3. I can visualize and draw multiple cross sections of a three-dimensional figure 4. I can solve problems involving density and volume 5. I can use the Pythagorean Theorem and trigonometry to help calculate volumes of prisms, cylinders, cones, and pyramids, including solids of rotation 6. I can calculate volumes of prisms, pyramids, and cones 7. I can work backward from a given volume to find possible dimensions of solids

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 5 End of Unit Assessment: Solid Geometry
Geometry-5-End-of-Unit-Assessment-teacher-guide.docx

1. I can identify the three-dimensional solid created by rotating a two-dimensional figure using a linear axis
TEST Question: #1

2. I know that when a solid is dilated by a scale factor of k, its surface area is multiplied by k^2 and its volume is multiplied by k^3
TEST Questions: #7

3. I can visualize and draw multiple cross sections of a three-dimensional figure
TEST Questions: #5

4. I can use the Pythagorean Theorem and trigonometry to help calculate volumes of prisms, cylinders, cones, and pyramids, including solids of rotation
TEST Question: #4

5. I can calculate volumes of prisms, pyramids, and cones
TEST Questions: #3

6. I can work backward from a given volume to find possible dimensions of solids

TEST Questions: #6

7. I can solve problems involving density and volume

TEST Questions: #2</td><td>Pre- Assessment: Geometry-5-Check-Your-Readiness-teacher-guide.docx

Geometry-5-Check-Your-Readiness-assessment

Ongoing Assessments: Unit 5 Cool Downs

Unit 5 Quizzes</td></tr>
<tr><td>• Performance Task: Given the dimensions of a drum and various amounts of helium to fill a giant balloon drum for a parade students must find the corresponding scale factor for each given amount of helium in order to answer the Essential Question: How does scaling two-dimensional and three-dimensional objects affect area and volume?
• Transfer Skills: Communication and Critical Thinking
• Understandings: #1
• Learning Targets: #2, #6</td><td></td></tr>
</table>

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Cross Sections, Scaling, and Area & Scaling Solids	**Estimated # of Lessons: 8**
Learning Target(s): 1. I can identify the three-dimensional solid created by rotating a two-dimensional figure using a linear axis 2. I know that when a solid is dilated by a scale factor of k, its surface area is multiplied by k^2 and its volume is multiplied by k^3 3. I can visualize and draw multiple cross sections of a three-dimensional figure	**Essential Questions:** How does scaling two-dimensional and three-dimensional objects affect area and volume?
Learning Activities: 1. Students create 3D solids by from 2D solids using an axis of rotation. 2. Students use technology to identify different cross sections of solids. 3. Find area and volume of dilated figures given a scale factor. 4. Find scale factors given area and the dilated area or volume and dilated volume.	
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Second Unit Topic: Working with Volumes	**Estimated # of Lessons: 10**
Learning Target(s): 4. I can solve problems involving density and volume 5. I can use the Pythagorean Theorem and trigonometry to help calculate volumes of prisms, cylinders, cones, and pyramids, including solids of rotation 6. I can calculate volumes of prisms, pyramids, and cones 7. I can work backward from a given volume to find possible dimensions of solids	**Essential Questions:** How do you extend what you know about two dimensional shapes to three dimensional solids?

Learning Activities:

1. Find volumes of composite solids
2. Determine volume formulas and properties for oblique solids
3. Construct a prism from three pyramids
4. Find missing measurements using trigonometry to solve for volume
5. Calculate density to solve real-world problems

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<table>
<tr><td colspan="2">COURSE NAME: Geometry Sixth Unit: Geometry IM6 Coordinate Geometry
Est. Time: 7 Weeks (17 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students encounter a new coordinate transformation notation which connects transformations to functions. They then use transformations and Pythagorean Theorem to build equations of circles, parabolas, parallel lines, and perpendicular lines from definitions as well as apply these ideas to proofs. Students also use weighted averages to scale figures and locate intersection points within a triangle.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSG-GPE.A: Translate between the geometric description and the equation for a conic section
HSG-GPE.B: Use coordinates to prove simple geometric theorems algebraically
HSG-CO.A: Experiment with transformations in the plane</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision.
MP #7 Look for and make use of structure
● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Creating algebraic equations based on definitions and prior knowledge allows for modeling of geometric figures in the coordinate plane</td><td>● How do we use algebra to perform transformations and model figures to solve problems?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>How to represent transformations, circles, and parabolas on the coordinate plane and algebraically</td><td>1. I can derive an equation for a parabola in the coordinate plane given a focus and a directrix
2. I understand how square binomials relate to the equation of a circle
3. I can complete the square to find the center and radius of a circle</td></tr>
</table>

How to use algebraic equations to justify claims about geometric theorems	4. I can use coordinate transformation notation to take points in the plane as inputs and give other points as outputs 5. I can gather information about a line and write its equation 6. I can calculate the coordinates of a point on a line segment that partitions the segment in a given ratio 7. I can use coordinates of figures to prove geometric theorems

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 6 End of Unit Assessment: Coordinate Geometry Geometry-6-End-of-Unit-Assessment-teacher-guide.docx 1. I can derive an equation for a parabola in the coordinate plane given a focus and a directrix TEST Question: #1 2. I understand how square binomials relate to the equation of a circle TEST Questions: #3 3. I can complete the square to find the center and radius of a circle TEST Questions: #4 4. I can use coordinate transformation notation to take points in the plane as inputs and give other points as outputs TEST Question: #5 5. I can gather information about a line and write its equation TEST Questions: #2 6. I can calculate the coordinates of a point on a line segment that partitions the segment in a given ratio TEST Questions: #6 7. I can use coordinates of figures to prove geometric theorems TEST Questions: #7	Pre- Assessment: Geometry-6-Check-Your-Readiness-teacher-guide.docx Ongoing Assessments: Unit 6 Cool Downs Unit 6 Quizzes
● **Performance Task**: Given a triangle in the plane, students are lead through finding points of concurrency using algebraic equations they must come up with in order to answer the Essential Question: How do we use algebra to perform transformations and model figures to solve problems? ● Transfer Skills: Communication and Critical Thinking ● Understandings: #2 ● Learning Targets: #5, #6	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Transformations & Conic Sections	**Estimated # of Lessons: 8**
Learning Target(s): 1. I can derive an equation for a parabola in the coordinate plane given a focus and a directrix 2. I understand how square binomials relate to the equation of a circle 3. I can complete the square to find the center and radius of a circle 4. I can use coordinate transformation notation to take points in the plane as inputs and give other points as outputs	**Essential Questions:** How do we use algebra to perform transformations and model figures to solve problems?
Learning Activities: **1.** Students find measures of geometric figures on the coordinate plane. **2.** Students use function rules to write and preform transformations on the plane. **3.** Students identify what transformations preserve size and similarity. **4.** Derive the equation of a circle on the plane. **5.** Complete the square to find the radius and center of a circle given its equation. **6.** Derive the equation of parabola given the focus and directrix. **7.** Identify if a given point is on a circle, parabola, line, or intersection of the figures.	
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Second Unit Topic: Proving Geometric Theorems Algebraically	**Estimated # of Lessons: 9**
Learning Target(s): 5. I can gather information about a line and write its equation 6. I can calculate the coordinates of a point on a line segment that partitions the segment in a given ratio 7. I can use coordinates of figures to prove geometric theorems	**Essential Questions:** How do we use algebra to perform transformations and model figures to solve problems?

Learning Activities: 1. Create point-slope form of the equation of a line 2. Prove that a parallelogram has opposite sides that are parallel lines 3. Prove perpendicular slopes are opposite reciprocals 4. Solve a system with a linear equation and quadratic equation 5. Calculate weighted averages to partition a given segment
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<table>
<tr><td colspan="2">COURSE NAME: Geometry Seventh Unit: Geometry IM7 Circles
Est. Time: 5 Weeks (14 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students analyze relationships between segments and angles in circles, leading to the construction of inscribed and circumscribed circles of triangles. Students solve problems involving arc length and sector area, and they use the similarity of all circles and ideas of arc length to develop the concept of radian measure for angles.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSG-C.A: Understand and apply theorems about circles
HSG-C.B: Find arc length and area of sectors of circles</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision.
MP #7 Look for and make use of structure
● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● There exists a relationship between different parts of a circle that can be used to find missing measurements and solve problems</td><td>● How do parts of a circle relate to each other in order to solve real-world problems?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>How to utilize knowledge of central angles and inscribed figures to find missing angle measures</td><td>1. I can use the relationship between central and inscribed angles to calculate angle measures
2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles
3. I can construct a circumscribed circle of a triangle</td></tr>
</table>

How to calculate measurements of arc length and sector area when given specific information about a circle	4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems 5. I can demonstrate that when a circle is dilated, some ratios stay constant 6. I can calculate lengths of arcs and areas of sectors in circles 7. I can calculate the area of a sector whose central angle measure is given in radians

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 End of Unit Assessment: Circles Geometry-7-End-of-Unit-Assessment-teacher-guide (1).docx 1. I can use the relationship between central and inscribed angles to calculate angle measures TEST Question: #1 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles TEST Questions: #2 3. I can construct a circumscribed circle of a triangle TEST Questions: #4 4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems TEST Question: #5 5. I can demonstrate that when a circle is dilated, some ratios stay constant TEST Questions: #3 6. I can calculate lengths of arcs and areas of sectors in circles TEST Questions: #6 7. I can calculate the area of a sector whose central angle measure is given in radians TEST Questions: #7	Pre- Assessment: Geometry-7-Check-Your-Readiness-teacher-guide.docx Geometry-7-Check-Your-Readiness-assessment Ongoing Assessments: Unit 7 Cool Downs Unit 7 Quizzes
● **Performance Task**: Given the diameter of a pizza and the price per slice from four different pizza vendors, students must decide which vendor offers the best deal in order to answer the Essential Question: How do parts of a circle relate to each other in order to solve real-world problems? ● Transfer Skills: Communication and Critical Thinking ● Understandings: #2 ● Learning Targets: #6	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Lines, Angles, and Polygons within Circles	**Estimated # of Lessons: 7**
Learning Target(s): 1. I can use the relationship between central and inscribed angles to calculate angle measures 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles 3. I can construct a circumscribed circle of a triangle 4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems	**Essential Questions:** How do parts of a circle relate to each other in order to solve real-world problems?
Learning Activities: 1. Define and identify parts of a circle. 2. Calculate and use inscribed angles to solve problems. 3. Define tangent lines and use them to solve problems. 4. Construct and draw conclusions of inscribed and circumscribed quadrilaterals. 5. Construct and draw conclusions of inscribed/ circumscribed triangles and circumcenters/ incenters.	
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Second Unit Topic: Measuring Circles	**Estimated # of Lessons: 7**
Learning Target(s): 5. I can demonstrate that when a circle is dilated, some ratios stay constant 6. I can calculate lengths of arcs and areas of sectors in circles 7. I can calculate the area of a sector whose central angle measure is given in radians	**Essential Questions:** How do parts of a circle relate to each other in order to solve real-world problems?

Learning Activities: 1. Calculate areas of sectors and measures of arc lengths 2. Work backward from given central angle measure to find area, radius, and circumference 3. Define radians by observing relationships between radius and arc length 4. Justify the formula for area of a sector in radians
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COURSE NAME: Geometry Eighth Unit: Geometry IM8: Conditional Probability **Est. Time: 5 Weeks (11 Lessons, class meets every other day)**	
OVERVIEW *In this unit, students extend their previous understandings of probability by considering events that are combined in various ways (both events occurring, at least one occurring, and one event occurring based on if another occurs first). This unit introduces the relationship between probabilities of a combination of events using the Addition Rule. Students also interact with conditional probability and explore the ideas of events being independent or dependent.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSS-CP.A:** Understand independence and conditional probability and use them to interpret data **HSS-CP.B:** Use the rules of probability to compute probabilities of compound events	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• By organizing data into two-way tables or Venn Diagrams, the data is isolated into specific cross sections, allowing conditional probabilities to be calculated for specific events	• How can we organize data to help determine the probability of an event occurring?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to create and use two-way tables to organize data and determine probability of conditional events	1. I can find or estimate probability using a model or data from a chance experiment. 2. I can estimate probabilities, including conditional probabilities from two-way tables. 3. I can use probabilities and conditional probabilities to decide if events are independent

	4. I can use information in a two-way table to find relative frequencies and to estimate probability.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 8 End of Unit Assessment: Conditional Probability
Geometry-8-End-of-Unit-Assessment-teacher-guide.docx

1. I can find or estimate probability using a model or data from a chance experiment
TEST Question: #1, #2

2. I can estimate probabilities, including conditional probabilities from two-way tables.
TEST Questions: #3, #4, #5

3. I can use probabilities and conditional probabilities to decide if events are independent
TEST Questions: #6

4. I can use information in a two-way table to find relative frequencies and to estimate probability
TEST Question: #7</td><td>Pre- Assessment:
Geometry-8-Check-Your-Readiness-teacher-guide.docx

Ongoing Assessments:
Unit 8 Cool Downs

Unit 8 Quizzes</td></tr>
<tr><td>• Performance Task: Students play rock, paper, scissors and record data in a two-way table to decide if “winning” is dependent on another event in order to answer the Essential Question: How can we organize data to help determine the probability of an event occurring?
• Transfer Skills: Communication and Critical Thinking
• Understandings: #1
• Learning Targets: #2, #3, #4</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Chance, Independence, and Related Events</td><td>Estimated # of Lessons: 11</td></tr>
<tr><td>Learning Target(s):
1. I can find or estimate probability using a model or data from a chance experiment.
2. I can estimate probabilities, including conditional probabilities from two-way tables.</td><td>Essential Questions:

How can we organize data to help determine the probability of an event occurring?</td></tr>
</table>

3. I can use probabilities and conditional probabilities to decide if events are independent 4. I can use information in a two-way table to find relative frequencies and to estimate probability	

Learning Activities:

1. Determine likelihood of different scenarios.
2. Create sample spaces to outline all possibilities.
3. Use a table of relative frequencies to determine conditional probability.
4. Interpret Venn diagrams.
5. Prove the addition rule of probability.
6. Determine whether events are independent or dependent.

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COURSE NAME: College Math Topics First Unit- Algebra 1- Unit 2 IM Linear Equations, Inequalities and Systems
Est. Time: 10 Weeks (26 Lessons, class meets every other day)

OVERVIEW
In this unit, students will build upon their previous middle school math experience of understanding how variables, expressions, equations, and inequalities could be used to represent quantities and relationships. Students further develop their capacity to solve real world problems through the analysis of equations and inequalities in different formats.

STAGE 1 ⟶ IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	TRANSFER
CSDE Content Standards: **HSA-REI.A:** Understand solving equations as a process of reasoning and explain the reasoning. **HSA-REI.B**: Solve equations and inequalities in one variable. **HSA-REI.C:** Solve systems of equations. **HSA-REI.D:** Represent and solve equations and inequalities graphically. **HSA-CED.A:** Create equations that describe numbers or relationships.	● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. ● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Realistic solutions to equations or inequalities require understanding of what the real-world scenario looks like regardless of the form (i.e., table, graph, or algebraically) ● Leveraging technology to demonstrate the relationship between equations and inequalities creates a dynamic representation of the real-world scenario for further possibilities.	● How do we construct and solve equations and inequalities to make sense of real-world problems? ● What does the equation or inequality look like on the graph? How does that reveal possible solutions to the real-world problem?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to construct and solve equations and systems of equations to model real life problems. How to construct inequalities and systems of inequalities to model real life problems.	1. I can construct and solve equations and look for values that satisfy the constraints and make the equations true. 2. I can investigate different ways to express the same relationship or constraint by analyzing and writing equivalent equations. 3. I can explore how the form and the parts of a linear equation in two variables are related to the features of its graph. 4. I can solve systems of equations by elimination and substitution explaining why the steps taken to eliminate the variable are valid and productive. 5. I can verify that a solution to an inequality in one or two variables is a value or a pair of values that makes the inequality true. 6. I can verify that a solution to a system of inequalities in two variables is any pair of values that make both inequalities in the system true. 7. I can construct and solve inequalities and look for values that satisfy the constraints and make the inequalities true.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 2 Mid-Assessment: Equations Algebra 2 Mid-Assessment 1. I can construct and solve equations and look for values that satisfy the constraints and make the equations true. TEST Question: #3, #4 2. I can investigate different ways to express the same relationship or constraint-by analyzing and writing equivalent equations. TEST Questions: #1, #2, #7 3. I can explore how the form and the parts of a linear equation in two variables are related to the features of its graph. TEST Question: #3, #5 4. I can solve systems of equations by elimination and substitution explaining why the steps taken to eliminate the variable are valid and productive. TEST Questions: #6, #7 Algebra1-2-End-of-Unit-Assessment-teacher-guide 5. I can see that a solution to an inequality in one or two variables is a value or a pair of values that makes the inequality true. TEST Questions: #1, #2, #4. #6 6. I can see that a solution to a system of inequalities in two variables is any pair of values that make both inequalities in the system true. TEST Questions: #1, #3, #5, #7 7. I can construct and solve inequalities and look for values that satisfy the constraints and make the inequalities true. TEST Questions: #6, #7	Pre- Assessment: Algebra 1 Unit 2 Check your Readiness Algebra1-2-Check-Your-Readiness-teacher-guide Ongoing Assessments: Algebra 1 Unit 2 Cool Downs Algebra 1 Unit 2 Quizzes
• **Performance Task**: Based on a nutritional chart for trail mix ingredients, students will be given constraints and a graph of a system of inequalities involving two of the ingredients where students must use the chart and the graph to identify which two ingredients are being used to answer the Essential Question: How do we construct	

and solve equations and inequalities to make sense of real-world problems? ● Transfer Skills: Communication and Critical Thinking ● Understandings: #1 ● Learning Targets: #5, 6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Equations and Systems of Equations.	**Estimated # of Lessons: 17**
1. I can construct and solve equations and look for values that satisfy the constraints and make the equations true. 2. I can investigate different ways to express the same relationship or constraint-by analyzing and writing equivalent equations. 3. I can explore how the form and the parts of a linear equation in two variables are related to the features of its graph. 4. I can solve systems of equations by elimination and substitution explaining why the steps taken to eliminate the variable are valid and productive.	**Essential Questions:** How do we construct and solve equations and inequalities to solve real life problems? What does the equation or inequality look like on the graph? What does that communicate to us in terms of the real-world problem?
Learning Activities: 1. Construct equations that describe relationships and constraints. 2. Given a linear equation solve for the correct solution and provide an explanation of what the solution means. 3. Graph equations in two variables. 4. Given an equation, rewrite the equation in different forms while maintaining the original solution. 5. Given a system of equations, solve the system graphically or by using substitution or elimination.	
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<table>
<tr><td>Second Unit Topic: Inequalities and Systems of Inequalities</td><td>Estimated # of Lessons: 9</td></tr>
<tr><td>Learning Target(s):

6. I can see that a solution to an inequality in one or two variables is a value or a pair of values that makes the inequality true.

7. I can see that a solution to a system of inequalities in two variables is any pair of values that make both inequalities in the system true.

8. I can construct and solve inequalities and look for values that satisfy the constraints and make the inequalities true.</td><td>Essential Questions:

• How do we construct and solve equations and inequalities to solve real life problems?

• What does the equation or inequality look like on the graph? What does that communicate to us in terms of the real-world problem?</td></tr>
<tr><td colspan="2">Learning Activities:

1. Construct inequalities that describe relationships and constraints.
2. Given a linear inequality, solve for the correct solution and provide an explanation of what the solution means.
3. Graph inequalities in two variables.
4. Given a system of inequalities, solve the system graphically.</td></tr>
<tr><td colspan="2">https://im.kendallhunt.com</td></tr>
</table>

<table>
<tr><td colspan="2">COURSE NAME: College Math Topics Second Unit- Algebra 1- Unit 1 IM : One-Variable Statistics
Est. Time: 5 Weeks (16 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students will build upon their previous middle school math experience in analyzing data through mean, median, and mode to now include measures of variation (standard deviation, mean absolute deviation). Students will then recognize outliers and determine whether they are a valid datapoint to include in modeling the set. Using a spreadsheet tool, students will enter in and/or construct the appropriate data display.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
S-ID.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).
S-ID.2: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
S-ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #3: Construct viable arguments.
MP #4: Model with mathematics
MP #5: Use appropriate tools strategically.
● CRITICAL THINKING: Analyze data in order to draw conclusions.
MP #8: Look for and express regularity in repeated reasoning.
● RESPONSIBLE CITIZENSHIP: Use technology ethically to promote positive, reliable, and factual information.
MP #3: Construct viable arguments.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Understanding variability helps you grasp the likelihood of unusual events.
● A visual display of data is deliberately designed to communicate a message based on the raw data collected.</td><td>● How do we make predictions and informed decisions based on current numerical information? How do we handle outliers when they appear in the data?
● What is this data display communicating? To what extent is the data display an accurate representation of the underlying data?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td></td><td>1. (FOUNDATIONAL) I can tell the difference between statistical and non-statistical</td></tr>
</table>

How to find the best measure of central tendency and measure of variation to represent the data. How to make decisions when faced with the presence of outliers and how they might impact measures of central tendency and variability.	questions and classify data as numerical or categorical. 2. I can calculate summary statistics using technology and interpret the values in context. 3. I can represent and interpret data using data displays and describe distributions using the appropriate terminology *(e.g., symmetric, skewed, uniform, and bell-shaped).* 4. I can compare measures of center and the standard deviation and the interquartile range for different data sets. 5. I can recognize outliers and understand the effect it has on the overall data set. 6. I can investigate the source of outliers and use that to make and justify decisions about excluding them from the data set.

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 1 Test: One Variable Statistics Algebra1-1-End-of-Unit-Assessment-teacher-guide.docx 1. I can tell the difference between statistical and non-statistical questions and classify data as numerical or categorical. TEST Questions: N/A 2. I can calculate summary statistics using technology and interpret the values in context. TEST Questions: #5, #6 3. I can represent and interpret data using data displays and describe distributions using the appropriate terminology *(e.g., symmetric, skewed, uniform, and bell-shaped).* TEST Questions: #1, #2, #3, #5, #6, #7a 4. I can compare measures of center and the standard deviation and the interquartile range for different data sets. TEST Questions: #1, #2, #3, #4 5. I can recognize outliers and understand the effect it has on the overall data set. TEST Questions: #3, #7bd 6. I can investigate the source of outliers and use that to make and justify decisions about excluding them from the data set. TEST Questions: #7c	Pre-Assessment: Algebra 1 Unit 1 Check your Readiness Ongoing Assessments: Algebra 1 Unit 1 Cool Downs Algebra 1 Unit 1 Quizzes
Performance Task: Based on contemporary problem, students will be given the context with a related data display and will analyze the data using the Essential Question: What is this data display communicating? To what extent is the data display an accurate representation of the underlying data? ● Transfer Skills: Communication, Critical Thinking, Responsible Citizenship* (depends on the design of data display) ● Understandings: #1, 2 ● Learning Targets: #3, 5, 6	

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: The Shape of Data and Measures of Central Tendency	**Estimated # of Lessons: 11**
Learning Target(s): 1. (FOUNDATIONAL) I can tell the difference between statistical and non-statistical questions and classify data as numerical or categorical. 2. I can calculate summary statistics using technology and interpret the values in context. 3. I can represent and interpret data using data displays and describe distributions using the appropriate terminology *(e.g., symmetric, skewed, uniform, and bell-shaped).* 4. I can compare measures of center and the standard deviation and the interquartile range for different data sets.	**Essential Questions:** ● How do we make predictions and informed decisions based on current numerical information?
Learning Activities: 1. Constructing frequency tables and histograms from raw data and then calculating the five-number summary in order to draw a box plot. 2. Given a set of dot plots and histograms, the student will identify the appropriate histogram to the corresponding dot plot, describe the shape of the data, and then create a statistical question that matches the shape of the data. 3. Analyzing raw data using Excel to calculate measures of central tendency, quartiles, interquartile range, and range. 4. Using Excel, the effect of extremes on the shape of a histogram will be explored by allowing students to type in different data values and watching the shape of the histogram change.	
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Second Unit Topic: Measures of Variation and Outliers	**Estimated # of Lessons: 5**
Learning Target(s):	**Essential Questions:**

5. I can recognize outliers and understand the effect it has on the overall data set. 6. I can investigate the source of outliers and use that to make and justify decisions about excluding them from the data set.	• How do we handle outliers when they appear in the data? • What is this data display communicating? To what extent is the data display an accurate representation of the underlying data?

Learning Activities:

1. Excel will be utilized to calculate the standard deviation of a data set and then values will be removed or added to the data set allowing students to decipher the effect of that removal or addition on the standard deviation, mean, median, and interquartile range.

2. The shape of a data set will be analyzed to determine which measures of central tendency and variation are most appropriate to describe the data.

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<table>
<tr><td colspan="2">COURSE NAME: College Math Topics Third Unit- Algebra 2 IM 7 : Statistical Inferences
Est. Time: 4 Weeks (16 lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit students will build on their middle school skills of collecting samples from a population and using information about those samples to estimate characteristics for the population. Here students will explore the normal distribution and apply understanding of the distribution to provide estimates with a margin of error. This unit will also look at experimental studies, observational studies, and surveys.</td></tr>
<tr><td colspan="2">STAGE 1 ⟶ IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSS-IC.A: Understand and evaluate random processes underlying statistical experiments.
HSS-IC.B: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
HSS-ID.A: Summarize, represent, and interpret data on a single count or measurement variable.</td><td>● CRITICAL THINKING: Identify a problem, ask key questions and make predictions.
MP #1: Make sense of problems and persevere in solving them.
MP #2 Reason abstractly and quantitatively.
● COMMUNICATION: Create a logical and evidence-based argument to support ideas.
MP #3 Construct viable arguments and critique the reasoning of others.
● RESEARCH AND UNDERSTANDING: Synthesize information to solve problems and defend claims.
MP #3 Construct viable arguments and critique the reasoning of others.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Use data collected from a sample of a population in question. A process of randomization is used to reduce the amount of bias in the sample. Create statistical measures from this population and use a margin of error to estimate how much the statistics will vary.
● Make inferences using the statistics and margin of error found from the sample. Use the inferences to answer questions about the normal distribution of the population.</td><td>● How can statistics be collected, displayed, and analyzed in an unbiased fashion?
● How can an event be both random and predictable?</td></tr>
</table>

KNOWLEDGE	SKILLS (framed as Learning Targets)
How to use different statistical questions based on the type of study. Emphasize the importance of random selection for gathering a sample for surveys and observational studies and the importance of random assignment in experimental studies. How to analyze data by examining the shapes of distributions and focusing on the normal distribution as a common and standardized shape. Data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. How to analyze the results from experimental studies to estimate population means and proportions with a margin of error based on data from surveys. How to determine whether experimental data is likely due to the chance arrangement of groups or the experimental treatment.	1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. 2. I can understand and be able to explain the importance of random selection for gathering a sample for surveys and observational studies. 3. I can understand the importance of random assignment in experimental studies. 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. 6. I can analyze the results from experimental studies. 7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance

	arrangement of the groups or the experimental treatment.

STAGE 2 ⟶ DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 Mid-Unit Assessment: Statistical Inferences Algebra 2 Unit 7 Mid-Unit Assessment 1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. Test Question #5, #7 2. I can understand and be able to describe the importance of random selection for gathering a sample for surveys and observational studies. Test Question #6 3. I can understand and be able to describe the importance of random assignment in experimental studies. Test Question #1, #6, #7 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. Test Questions: #2, #3, #7 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals. Test Questions: #3, #7 6. I can analyze the results from experimental studies. Test Questions: #4, #7	Pre- Assessment: Algebra 2 Unit 7 Check your Readiness Ongoing Assessment: Algebra 1 Unit 7 Cool Downs Algebra 1 Unit 7 Quizzes

7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. Test Question: not yet addressed. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. Test Question #4 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Test Question #5 Unit 7 End of Unit Assessment: Statistical Inferences Algebra 2 Unit 7 End of Unit Assessment 1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. Test Question #7 2. I can understand and be able to describe the importance of random selection for gathering a sample for surveys and observational studies. Test Question #5 3. I can understand and be able to describe the importance of random assignment in experimental studies. Test Question #3, #4 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. Test Question #7 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional	

information such as the proportion of data expected within certain intervals. Test Question #7 6. I can analyze the results from experimental studies. Test Question #3, 5 7. I can understand what margin of error means and be able to estimate margin of error using the mean and standard deviation. Test Question #1, #2, #6 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section. Test Question #2, #4 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Test Question #5, #7	
Performance Task: Students collect data from an experiment involving their heart rates and analyze the data using randomization distributions. An understanding of the normal distribution is used to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment. Used to answer the essential question: How can an event be both random and predictable? ● Transfer Skills: Research and Understanding ● Understandings: #2 ● Learning Target: #9	Algebra 2 Unit 7 Lesson 16 Heart Rates

STAGE 3 ⟶ LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Study Types	**Estimated # of Lessons: 3**
Learning Target(s):	**Essential Question:**

1. I can explore statistical questions and the type of study that is used to answer different kinds of questions. 2. I can understand and be able to explain the importance of random selection for gathering a sample for surveys and observational studies. 3. I can understand and be able to explain the importance of random assignments in experimental studies.	• How can statistics be collected, displayed, and analyzed in an unbiased fashion?
Learning Activities: 1. Decide if a study is good or bad based on evidence. 2. Recognize the difference between a survey, observational study, or experimental study. 3. Understand why randomization is important in the design of a study. 4. Describe the different purposes for each type of study design (survey, observational study, or experimental study). 5. Recognize the difference between a survey, observational study, or experimental study. 6. Understand that the choice of the design for a study will impact what questions can be answered. 7. Recognize that the way a sample is chosen matters, and that random samples have less bias.	
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Second Unit Topic: Distributions	**Estimated # of Lessons: 4**
Learning Target(s): 4. I can analyze data collected by examining the shapes of distributions while focusing on the normal distribution as a common and standardized shape. 5. I can recognize that data with an approximately normal shape can be modeled by a normal distribution to gain additional information such as the proportion of data expected within certain intervals.	**Essential Question:** • How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities:

1. Describe a distribution using the characteristics of its shape, center, and spread.
2. Use the standard deviation to describe the variability in a distribution.
3. Calculate a relative frequency and create a relative frequency histogram.
4. Know that a normal curve is defined using the mean and standard deviation.
5. Calculate a proportion of a set of data that matches a shaded area in a histogram.
6. Recognize the patterns of proportions that occur in distributions that are approximately normal in shape.
7. Use the mean and standard deviation of a normally distributed data set to estimate intervals when given a proportion.
8. Use the mean and standard deviation of a normally distributed data set to estimate proportions.

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Third Unit Topic: Not all Samples are the Same	**Estimated # of Lessons: 5**
Learning Target(s): 6. I can analyze the results from experimental studies. 7. I can understand what margin of error means and be able to estimate using the mean and standard deviation. 8. I can estimate population means and proportions with a margin of error using data from surveys and observational studies using random samples. This analysis is based on the understanding of the normal distribution gained in the previous section.	**Essential Question:** ● How can statistics be collected, displayed, and analyzed in an unbiased fashion?

Learning Activities:

1. Justify a mathematical claim using evidence.
2. Use mathematical evidence to find the difference between when outcomes are unfair or due to random chance.
3. Understand why it is important to be skeptical of data that seems unfair.
4. Estimate the margin of error using the mean and standard deviation.
5. Understand that sample means, and proportions can be representative of the overall population.
6. Understand that sample means and proportions vary.

7. Estimate the margin of error using standard deviation.
8. Understand that a larger margin of error means more variability, and I should be less confident in my estimate of the population mean.
9. Understand that a smaller margin of error means more variability, and I can be more confident in my estimate of the population mean.
10. Understand that different samples from the same population can still have different statistics.
11. Describe why a larger sample size usually leads to a smaller margin of error.
12. Understand that sample size influences the size of the margin of error for a data set.
13. Calculate the mean and standard deviation of sample means and use the information to estimate the margin of error.
14. Understand that sample means that are normally distributed follow the same pattern as sample proportions.

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Fourth Unit Topic: Analyzing Experimental Data	**Estimated # of Lessons: 4**
Learning Target(s): 9. I can use my understanding of the normal distribution, this time to determine whether the experimental data is likely due to the chance arrangement of the groups or the experimental treatment.	**Essential Questions:** ● How can an event be both random and predictable?

Learning Activities:

1. Find the difference between two treatment means and use a randomization distribution to determine whether the result occurred by random chance.
2. Understand why randomization is important in the design of a study.
3. Calculate the difference in means between two groups.
4. Justify whether there is evidence for a statistical claim by using proportions in the normal distribution.
5. Understand that the difference in means can be modeled by a distribution that is approximately normal in shape.
6. Use a randomization distribution to determine whether a treatment was the cause of the results of an experiment, or if the results are due to the random assignment of the groups.
7. Understand why it is important to question the results of an experiment.

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COURSE NAME: College Math Topics Forth Unit- Algebra 1 Unit 5 IM: Exponentials Est. Time: 5 Weeks (21 Lessons, class meets every other day)	
OVERVIEW *In this unit, students will use their understanding of exponential growth and decay to build models representing real world phenomena and make predictions using these models.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSF-LE.A:** Construct and compare linear, quadratic, and exponential models and solve problems. **HSF-LE.B:** Interpret expressions for functions in terms of the situation they model. **HSA-SSE.A:** Interpret the structure of expressions. **HSA-CED.A:** Create equations that describe numbers or relationships. **HSF-IF.B:** Interpret functions that arise in applications in terms of the context. **HSF-IF.C:** Analyze functions using different representations.	● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them. MP #4: Model with mathematics. MP #8: Look for and express regularity in repeated reasoning.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
● Modeling of real-world scenarios, with the use of a function, allows for predictions to be made in the past or in the future.	● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**

How to construct the model of an exponential function so that predictions can be made by evaluating the function.	1. I can compare growth patterns using calculations and graphs. 2. I can write and interpret an equation that represents exponential growth or decay. 3. I can write and graph an equation that represents exponential growth or decay to solve problems. 4. I can explain the meanings of *a* and *b* in an equation that represents exponential growth or decay and is written as $y = a \cdot b^{x}$. 5. I know how the average rate of change of an exponential function differs from that of a linear function. 6. I can use exponential functions to model situations that involve exponential growth or decay. 7. I can find the result of applying a percent increase or decrease on a quantity. 8. I can calculate interest when I know the starting balance, interest rate, and compounding intervals.

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Algebra1-5-Mid-Unit-Assessment-teacher-guide

1. I can compare growth patterns using calculations and graphs.
Test Questions: #1

2. I can write and interpret an equation that represents exponential growth or decay.
Test Questions: #2, #4, #5, #6

3. I can write and graph an equation that represents exponential growth or decay to solve problems.
Test Questions: #3, #6, #7

4. I can explain the meanings of a and b in an equation that represents exponential growth or decay and is written as $y = a \cdot b^x$.
Test Questions: #2, #4, #5, #6, #7

Algebra 1-5-End-of-Unit-Assessment-teacher-guide

5. I know how the average rate of change of an exponential function differs from that of a linear function.
Test Questions: #7

6. I can use exponential functions to model situations that involve exponential growth or decay.
Test Questions: #1, #2, #4, #6

7. I can find the result of applying a percent increase or decrease on a quantity.
Test Questions: #1, #2, #3, #5

8. I can calculate interest when I know the starting balance, interest rate, and compounding intervals.
Test Questions: #4, #7</td><td>Pre- Assessment:

Algebra 1 Unit 5 Check Your Readiness

Ongoing Assessments:
Unit 5 Cool Downs

Unit 5 Quizzes</td></tr>
<tr><td>• Performance Task: Students will be given the population of Paris, Austin, and Chicago from 1950 to 2000. Using this data, students will need to decide if the population can be modeled using a linear or exponential function. Students must then create a function modeling the population change, graph the function, compare the results of</td><td></td></tr>
</table>

the function to the actual population, and then make predictions for the population in the years 2010 and 2050. This task answers the Essential Question: What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios? · Transfer Skills: Critical Thinking · Understandings: #1 · Learning Targets: #1, 2, 3, 5, 6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Exponential Growth and Decay.	**Estimated # of Lessons: 13**
1. I can compare growth patterns using calculations and graphs. 2. I can write and interpret an equation that represents exponential growth or decay. 3. I can write and graph an equation that represents exponential growth or decay to solve problems. 4. I can explain the meanings of *a* and *b* in an equation that represents exponential growth or decay and is written as $y = a \cdot b^x$.	**Essential Questions:** ● What is an exponential function and how are exponential functions defined to model and predict behavior of real-world scenarios?

Learning Activities:

1. Use Excel to determine the difference between succeeding values in a table to determine whether growth is linear or exponential.
2. Given an incomplete table of values, determine what 3^0 and 3^{-x} represent.
3. Given the initial value of a vehicle and the fraction of its value it loses each year, determine an equation that models the vehicle's value.
4. Given an equation which represents the area covered by algae, create a graph to represent the area covered for the first 4 weeks.

5. Given a scenario where the amount of coral doubles each year, be able to model the growth with an equation and determine how much coral there was in previous years using negative exponents. 6. Given a table of the number of coffee shops opened over a 10 year period, determine the average rate of change over multiple year intervals. 7. Use Desmos to determine how changing the value of *a* and then the value of *b* affect the graphs of exponential functions. 8. Given two points on the graph of an exponential function, determine the equation of the function.
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Second Unit Topic: Percent Change and Compound Interest.	**Estimated # of Lessons: 8**
Learning Target(s): 5. I know how the average rate of change of an exponential function differs from that of a linear function. 6. I can use exponential functions to model situations that involve exponential growth or decay. 7. I can find the result of applying a percent increase or decrease on a quantity. 8. I can calculate interest when I know the starting balance, interest rate, and compounding intervals.	**Essential Questions:** ● What is an exponential function and how are exponential functions defined to model and predict behavior of real- world scenarios?
Learning Activities: 1. Given different scenarios involving percent increase or decrease, calculate the final cost of the product. 2. Given an initial balance and monthly interest rate, determine the amount in a bank account after several different time periods. 3. Given a credit card balance and an annual interest rate compounded monthly, determine the effective annual interest rate.	

4. Given a table of values for simple interest and compound interest, derive equations that model both situations.
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<table>
<tr><td colspan="2">COURSE NAME: College Math Topics Fifth Unit- Geometry- Unit 3 IM Similarity
Est. Time: 6 Weeks (16 Lessons, class meets every other day)</td></tr>
<tr><td colspan="2">OVERVIEW
In this unit, students use dilations and rigid transformations to justify triangle similarity theorems including the Angle-Angle Triangle Similarity Theorem. Students build on their work with congruence and rigid motions, establishing that triangles are similar by dilating them strategically. Additionally, students work more with proofs as well as finding missing side lengths and angle measurements.</td></tr>
<tr><td colspan="2">STAGE 1 → IDENTIFY DESIRED RESULTS</td></tr>
<tr><td>ESTABLISHED GOALS</td><td>TRANSFER</td></tr>
<tr><td>CSDE Content Standards:
HSG-SRT.A: Understanding similarity in terms of similarity transformations
HSG-SRT.B: Prove theorems involving similarity</td><td>● COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision.
MP #7 Look for and make use of structure
● CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.</td></tr>
<tr><td>UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>● Dilations are transformations based on scale factors and center where corresponding sides are proportional and angles preserve measure
● Scaled models that hold proportionality can be used to find heights and lengths of large objects in the real-world</td><td>● What is the relationship between a figure and its scaled image?
● How can we use similarity to solve real-world problems?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS (framed as Learning Targets)</td></tr>
<tr><td>How to use dilations and scale factors to prove similarity in triangles</td><td>1. I can explain what happens to lines and angles in a dilation
2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally</td></tr>
</table>

How to use properties of right triangles to determine triangle similarity	3. I can find scale factors and use them to solve problems 4. I can calculate the lengths of parts of a scaled drawing 5. I can dilate a figure given a scale factor and center 6. I can critique proofs that use similarity 7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle

<table>
<tr><th colspan="2">STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE</th></tr>
<tr><th>Summative Assessments</th><th>Formative Assessments</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Unit 3 End of Unit Assessment: Similarity
Geometry-3-End-of-Unit-Assessment-teacher-guide.docx

1. I can explain what happens to lines and angles in a dilation
TEST Question: #1

2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally
TEST Questions: #2

3. I can find scale factors and use them to solve problems
TEST Question: #3

4. I can calculate the lengths of parts of a scaled drawing
TEST Questions: #4

5. I can dilate a figure given a scale factor and center
TEST Questions: #5

6. I can critique proofs that use similarity
TEST Questions: #6

7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle
TEST Questions: #7</td><td>Pre- Assessment:
Geometry-3-Check-Your-Readiness-teacher-guide.docx

Ongoing Assessments:
Unit 3 Cool Downs

Unit 3 Quizzes</td></tr>
<tr><td>• Performance Task: The height of a school building is unknown. Given their height, their distance to the mirror, and the distance from the mirror to the building, students must use similarity in order to answer the Essential Question: how can we use similarity to solve real-world problems?
• Transfer Skills: Communication and Critical Thinking
• Understandings: #1
• Learning Targets: #1, #3, #4</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION</th></tr>
<tr><td>First Unit Topic: Dilations and Proportional Reasoning</td><td>Estimated # of Lessons: 12</td></tr>
<tr><td>Learning Target(s):
1. I can explain what happens to lines and angles in a dilation</td><td>Essential Questions:</td></tr>
</table>

2. I can explain why a segment parallel to one side of a triangle divides the other sides proportionally 3. I can find scale factors and use them to solve problems 4. I can calculate the lengths of parts of a scaled drawing 5. I can dilate a figure given a scale factor and center 6. I can critique proofs that use similarity	• What is the relationship between a figure and its scaled image?
Learning Activities: 1. Perform dilations given a center and scale factor. 2. Find ratios of corresponding lengths after a dilation. 3. Use dilations to write proofs about parallel lines. 4. Determine if figures are similar by definition. 5. Disprove and prove statements about similar figures. 6. Determine if figures are similar by Angle-Angle, Side-Side-Side, and Side-Angle-Side	
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Second Unit Topic: Similarity in Right Triangles	**Estimated # of Lessons: 4**
Learning Target(s): 7. I can find similar triangles formed by the altitude to the hypotenuse in a right triangle	**Essential Questions:** • How can we use similarity to solve real-world problems?
Learning Activities: 1. Use Pythagorean Theorem to find missing side lengths in right triangles 2. Prove Pythagorean Theorem 3. Use triangle similarity properties to find unknown measurements in triangles 4. Calculate the angle required to make a bunker shot in billiards scenario	
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COURSE NAME: College Math Topics Sixth Unit- Geometry Unit 4 IM- Right Triangle Trigonometry
Est. Time: 5 Weeks (11 Lessons, class meets every other day)

OVERVIEW
In this unit, students build an understanding of ratios in right triangles which leads to naming cosine, sine, and tangent as trigonometric ratios. Practicing without naming the ratios allows students to connect similarity, proportional reasoning, and scale factors to right triangles with a specific acute angle. Students encounter several contexts to both make sense of and apply right triangle measurement.

STAGE 1 ⟶ IDENTIFY DESIRED RESULTS

ESTABLISHED GOALS	TRANSFER
CSDE Content Standards: **HSG-SRT.C:** Define trigonometric ratios and solve problems involving right triangles.	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• Ratios of sides in any sized right triangle are consistent and can be named which allows us to utilize them in any context to find missing lengths and angle measures	• How can trigonometric ratios allow us to model real-world scenarios and solve problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to identify, name, and use trigonometric ratios to find missing measurements in right triangles	1. I can determine the side lengths of triangles with 30, 60, and 90 degree angles 2. I can build a table of ratios of side lengths of right triangles 3. I can use trigonometry to solve problems

	4. I can use cosine, sine, and tangent to find side lengths of right triangles 5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 4 End of Unit Assessment: Right Triangle Trigonometry Geometry-4-End-of-Unit-Assessment-teacher-guide.docx 1. I can determine the side lengths of triangles with 30, 60, and 90 degree angles TEST Question: #1 2. I can build a table of ratios of side lengths of right triangles TEST Questions: #2 3. I can use trigonometry to solve problems TEST Question: #3, #6, #7 4. I can use cosine, sine, and tangent to find side lengths of right triangles TEST Questions: #4 5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle TEST Questions: #5	Pre- Assessment: Geometry-4-Check-Your-Readiness Assessment Ongoing Assessments: Unit 4 Cool Downs Unit 4 Quizzes
● **Performance Task**: Given a regular n-sided polygon of radius 1, students must partition the polygon into "n" triangles to find the perimeter and approximate pi in order to answer the Essential Question: How can trigonometric ratios allow us to model real-world scenarios and solve problems? ● Transfer Skills: Communication and Critical Thinking ● Understandings: #1 ● Learning Targets: #3, #4	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Relationships in Right Triangles & Trigonometric Ratios	**Estimated # of Lessons: 11**
Learning Target(s):	**Essential Questions:**

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1. I can determine the side lengths of triangles with 30-, 60-, and 90-degree angles
2. I can build a table of ratios of side lengths of right triangles
3. I can use trigonometry to solve problems
4. I can use cosine, sine, and tangent to find side lengths of right triangles
5. I can explain why the sine of an angle is equal to the cosine of 90 minus that angle

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- How can trigonometric ratios allow us to model real-world scenarios and solve problems?

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Learning Activities:

1. Find lengths of special right triangles.
2. Create a trigonometric ratio table.
3. Use trigonometric ratios to find side lengths of right triangles.
4. Relate sine and cosine ratios of complementary angles.
5. Using inverse trigonometric ratios to find missing angles of right triangles.
6. Use trigonometry to solve real world problems.

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COURSE NAME: College Math Topics **Seventh Unit- Geometry Unit 7 IM Circles Est. Time: 5 Weeks (14 Lessons, class meets every other day)**	
OVERVIEW *In this unit, students analyze relationships between segments and angles in circles, leading to the construction of inscribed and circumscribed circles of triangles. Students solve problems involving arc length and sector area, and they use the similarity of all circles and ideas of arc length to develop the concept of radian measure for angles.*	
STAGE 1 → IDENTIFY DESIRED RESULTS	
ESTABLISHED GOALS	**TRANSFER**
CSDE Content Standards: **HSG-C.A:** Understand and apply theorems about circles **HSG-C.B:** Find arc length and area of sectors of circles	• COMMUNICATION: Create a logical and evidence-based argument to support ideas. MP #6 Attend to Precision. MP #7 Look for and make use of structure • CRITICAL THINKING: Demonstrate flexibility and determination when solving problems. MP #1: Make sense of problems and persevere in solving them.
UNDERSTANDINGS	**ESSENTIAL QUESTIONS**
• There exists a relationship between different parts of a circle that can be used to find missing measurements and solve problems	• How do parts of a circle relate to each other in order to solve real-world problems?
KNOWLEDGE	**SKILLS (framed as Learning Targets)**
How to utilize knowledge of central angles and inscribed figures to find missing angle measures	1. I can use the relationship between central and inscribed angles to calculate angle measures 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles 3. I can construct a circumscribed circle of a triangle

How to calculate measurements of arc length and sector area when given specific information about a circle	4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems 5. I can demonstrate that when a circle is dilated, some ratios stay constant 6. I can calculate lengths of arcs and areas of sectors in circles 7. I can calculate the area of a sector whose central angle measure is given in radians

STAGE 2 → DETERMINE ACCEPTABLE EVIDENCE	
Summative Assessments	**Formative Assessments**
Unit 7 End of Unit Assessment: Circles Geometry-7-End-of-Unit-Assessment-teacher-guide (1).docx 1. I can use the relationship between central and inscribed angles to calculate angle measures TEST Question: #1 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles TEST Questions: #2 3. I can construct a circumscribed circle of a triangle TEST Questions: #4 4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems TEST Question: #5 5. I can demonstrate that when a circle is dilated, some ratios stay constant TEST Questions: #3 6. I can calculate lengths of arcs and areas of sectors in circles TEST Questions: #6 7. I can calculate the area of a sector whose central angle measure is given in radians TEST Questions: #7	Pre- Assessment: Geometry-7-Check-Your-Readiness Ongoing Assessments: Unit 7 Cool Downs Unit 7 Quizzes
● **Performance Task**: Given the diameter of a pizza and the price per slice from four different pizza vendors, students must decide which vendor offers the best deal in order to answer the Essential Question: How do parts of a circle relate to each other in order to solve real-world problems? ● Transfer Skills: Communication and Critical Thinking ● Understandings: #2 ● Learning Targets: #6	

STAGE 3 → LEARNING PLAN EXPERIENCES and INSTRUCTION	
First Unit Topic: Lines, Angles, and Polygons within Circles	**Estimated # of Lessons: 7**
Learning Target(s): 1. I can use the relationship between central and inscribed angles to calculate angle measures 2. I can use a theorem about opposite angles in quadrilaterals inscribed in circles 3. I can construct a circumscribed circle of a triangle 4. I can use the relationship between tangent lines and radii to calculate angle measures and prove geometric theorems	**Essential Questions:** How do parts of a circle relate to each other in order to solve real-world problems?
Learning Activities: 1. Define and identify parts of a circle. 2. Calculate and use inscribed angles to solve problems. 3. Define tangent lines and use them to solve problems. 4. Construct and draw conclusions of inscribed and circumscribed quadrilaterals. 5. Construct and draw conclusions of inscribed/ circumscribed triangles and circumcenters/ incenters.	
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Second Unit Topic: Measuring Circles	**Estimated # of Lessons: 7**
Learning Target(s): 5. I can demonstrate that when a circle is dilated, some ratios stay constant 6. I can calculate lengths of arcs and areas of sectors in circles 7. I can calculate the area of a sector whose central angle measure is given in radians	**Essential Questions:** How do parts of a circle relate to each other in order to solve real-world problems?

Learning Activities: 1. Calculate areas of sectors and measures of arc lengths 2. Work backward from given central angle measure to find area, radius, and circumference 3. Define radians by observing relationships between radius and arc length 4. Justify the formula for area of a sector in radians
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