Windham School District

Math 9-12 Curriculum

Approved by the Windham School Board on 7/12/2022

WINDHAM SCHOOL DISTRICT
Math

TEAM

All of the math teachers, K-12, participated in the mathematics curriculum by reading, writing, offering input, and editing the mathematics curriculum. This collaboration was extremely valuable.

A special thank you to the following teachers who also took time out of their summer vacation to help lead the mathematics curriculum review:

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Mission Statement

The Windham School District K-12 Mathematics Curriculum has undergone a formal review and revision during the 2021-2022 school year. Previously, the mathematics curriculum was approved in April 2018. Mathematics teachers, representing all grade levels, worked together to revise the math curriculum to ensure that it is a comprehensive math curriculum incorporating both the Common Core State Standards as well as Local Windham School District Standards. There was also a vertical review of core mastery standards to ensure that teachers are emphasizing the same key concepts through a spiral review format. This will help ensure that students are prepared for both state assessments as well as the following grade level or course.

There are three versions of the Windham K-12 Math Curriculum. By grade level or course, there is a summary overview section followed by a more detailed version of the curriculum. The summary overview section gives both parents and teachers a quick list of the concepts to be taught, which includes both vocabulary and skills that will be learned. The second detailed version of the curriculum also includes essential questions and the formal list of Common Core Standards. At the end of this document, there is also a mastery overview document. This document shows the concepts and skills, per grade level or course, that will be emphasized, reviewed, and assessed multiple times throughout the school year.

Title of Curriculum: Algebra 1

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Solving Equations and Inequalities	● Literal and algebraic equations ● Absolute value ● Percents ● Proportions ● Inequalities ● Compound inequalities ● Graphs of Linear inequalities	● When solving equations equality must be preserved by performing the same operations on both sides of an equation. ● There are differences between solutions to inequalities and equations.	● Write and solve multistep equations with rational coefficients ● Write and solve multi-step one variable inequalities and graph them on a number line ● Solve and graph compound inequalities ● Solve absolute value equations ● Solve literal equations ● Write and solve proportions including ones with binomials in the numerator or denominator ● Solve application percent problems
Unit 2: Linear Relationships	● slope as rate of change ● forms of linear equations ● arithmetic sequences ● direct variation ● equations of lines in slope-intercept form, point slope form, and standard form. ● slopes of lines that are perpendicular and parallel to a given point or line ● properties of horizontal and vertical lines. ● scatterplots ● line of best fit ● Correlation	● Linear relationships have a constant rate of change ● Tables, graphs, and equations are interconnected ways of representing data and real world phenomena ● Visual displays can model data and be used to make predictions	● Calculate slope between two points ● Determine the slope of a line, given an equation, table, or graph ● Determine whether lines are parallel, perpendicular, or neither ● Find intercepts given graphs and equations ● Graph linear equations ● Write a rule given an arithmetic sequence ● Write equations of lines given specific characteristics ● Create and interpret linear equations from real world data ● Calculate the line of best fit ● Determine if there is a correlation between bivariate data ● Make predictions based on the line of best fit ● Use the line of best fit to find the starting point represented by the y-intercept and to describe the slope in context.

Unit 3: Foundations of Functions and Expressions	● Function Notation ● representations of relations (mapping, tables, graphs, equations) ● function and relation ● Translations between words and mathematical expressions ● domain and range of a function ● Solutions	● Relations and functions can represent real world phenomena ● A function is a special relationship between values; each input value gives back exactly one output value.	● Determining whether a relation is a function. ● Apply mathematical properties to functions ● Representing relations using different formats ● Evaluating a function ● Writing function rules from tables and word problems ● Determining the domain and range of various functions ● ● Graphing absolute value functions with transformations. ● With technology, recognizing linear and quadratic functions given data and graphs.
Unit 4: Linear Systems	● systems of linear equations. ● the intersection point of two lines is the solution of the system ● systems of linear inequalities (2 variables) ● the overlapping shaded solution is the solution to the system of inequalities	● There is more than one way to solve a system of equations. ● Based on the given information there is a best method to use. ● Systems of equations with two unknowns can be used to solve real world problems.	● Write and solve linear systems by graphing, elimination, and substitution methods ● Determine most efficient method for solving a given system of equation ● Distinguish if a system of equations has one solution, no solution, or infinitely many solutions ● Graph systems of linear inequalities ● Graph linear inequalities in the coordinate plane ● Create and interpret linear inequalities in one variable ● Model real world situations with systems of equations
Unit 5: Polynomials	● polynomial, trinomial, and binomial ● degree and standard form of a polynomial ● properties of exponents ● negative exponents ● Operations with polynomials	● Exponent properties are the foundations for many algebraic concepts. ● There are many equivalent versions of polynomial expressions found by simplifying, adding,	● simplify monomials using rules of exponents including zero power and negative exponents ● Add, subtract, and multiply polynomials ● Find perimeter and area involving polynomials ● factoring out GCF ● factoring trinomials with a = 1 and a ≠ 1

	● scientific notation ● quadratic equations ● Greatest common factor ● Factoring polynomials	subtracting, multiplying, and factoring expressions. ● Very large and very small numbers can be represented efficiently using scientific notation.	● factoring binomials by difference of squares ● Solve quadratic equations by factoring ● Multiply and divide numbers in scientific notation
Unit 6: Radicals	● Radical ● Pythagorean theorem ● Rationalize Denominator	● Radicals can be represented in different yet equivalent forms.	● Simplify radicals ● Add, subtract, multiply, and divide radicals ● Solve problems involving the Pythagorean theorem

Windham School District Curriculum
Algebra 1
Unit 1: Solving Equations and Inequalities

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solidify their skills in solving advanced linear equations and inequalities.

Content Standards:

- CCSS.HSA.REI.10. Represent and solve equations and inequalities graphically. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane often forming a curve (which could be a line).
- CCSS.HSA.REI.12. Represent and solve equations and inequalities graphically. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- CCSS.HSA.CED.1. Create equations and inequalities in one variable and use them to solve problems.
- CCSS.HSA.REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CCSS.HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Transfer

Students will be able to independently use their learning to…

- fluently solve multi-step linear equations
- use these skills in many applications as well as future mathematics classes.

Meaning

ENDURING UNDERSTANDINGS

- When solving equations, equality must be preserved by performing the same operations on both sides of an equation.
- There are differences between solutions to inequalities and equations.

ESSENTIAL QUESTIONS

- How do you use equations to model real world problems?
- How can an equation or inequality be manipulated to isolate a variable while preserving the equality of the original equation/inequality?

Acquisition

Students will understand…

- literal and algebraic equations.
- absolute value equations.
- percents
- proportions
- inequalities
- compound inequalities.
- Graphs of Linear inequalities
- algebraic proofs

Students will be skilled at…

- writing and solving multistep equations with rational coefficients.
- writing and solving multi-step one-variable inequalities.
- using properties to justify the steps in solving equations
- graphing inequalities on a number line.
- solving and graphing compound inequalities.
- solving absolute value equations.
- solving literal equations.

● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● writing and solving proportions with binomials in the numerator and denominator. ● Solving application percent problems.
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1
Unit 2: Linear Relationships

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will explore linear relationships.

Content Standards:

- CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- CCSS.HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- CCSS.HSF.IF.C.7.A: Graph linear … functions and show intercepts....
- CCSS.HSF.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- CCSS.HSF.IF.C.9: Compare properties of two functions each represented in a different way

Transfer

Students will be able to independently use their learning to…

- see the connection between equations and graphs.
- use their knowledge of using tables to graph other functions.

Meaning

ENDURING UNDERSTANDINGS

- Linear relationships have a constant rate of change.
- Tables, graphs, and equations are interconnected ways of representing functions and real world phenomena.
- Visual displays can model data and be used to make predictions.

ESSENTIAL QUESTIONS

- How can graphs be used to solve linear equations?
- How do you determine the appropriate form of an equation for a line when given specific characteristics?
- What is the relationship between slope and rate of change and how can each be used to solve real world problems?

Acquisition

Students will understand…

- slope as rate of change
- forms of linear equations
- arithmetic sequences
- direct variation
- equations of lines in slope-intercept form, point slope form, and standard form.
- slopes of lines that are perpendicular and parallel to a given point or line
- properties of horizontal and vertical lines.
- scatterplots

Students will be skilled at…

- calculating slope between two points.
- determining the slope of a line given an equation, table or graph.
- determining whether lines are parallel, perpendicular, or neither.
- finding intercepts given graphs and equations.
- graphing linear equations.
- writing a rule given an arithmetic sequence.
- writing equations of lines given specific characteristics.

(algebraically, graphically, numerically in tables, or by verbal descriptions). ● CCSS.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. CCSS.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). ● CCSS.HSF.LE.A.2: Construct linear... functions, including arithmetic...sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). ● CCSS.HSF.LE.A.1.B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. ● CCSS.HSF.LE.B.5: Interpret the parameters in a linear...function in terms of a context. ● CCSS.HSS.ID.B.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. CCSS.HSS.ID.B.6.c: Fit a linear function for a scatter plot that suggests a linear association.	● line of best fit ● correlation	● creating and interpreting linear equations from real world data. ● Calculating the line of best fit ● Determining if there is a correlation between bivariate data ● making predictions based on the line of best fit ● Using the line of best fit to find the starting point represented by the y-intercept and to describe the slope in context.
Used in Content Area Standards		***21st Century Skills***
CCSS.MP4: Model with mathematics CCSS.MP7: Look for and make use of structure CCSS.MP5 Use appropriate tools strategically		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1
Unit # 3: Foundations of Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will gain a deeper understanding of functions including functional notation.

Content Standards:

- CCSS.HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).
- CCSS.HSF.IF.A.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- CCSS.HSF.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- CCSS.HSF.IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Transfer

Students will be able to independently use their learning to…

- apply their basic knowledge of functions when exploring linear, quadratic, and higher-order functions.

Meaning

ENDURING UNDERSTANDINGS

- Relations and functions can represent real world phenomena.
- A function is a special relationship between values; each input value gives back exactly one output value.

ESSENTIAL QUESTIONS

- When is a relation actually a function?
- How do relations and functions relate to real world problems?

Acquisition

Students will understand…

- function notation
- representations of relations (mapping, tables, graphs, equations)
- function and relation
- Translations between words and mathematical expressions
- domain and range of a function
- Solutions

Students will be skilled at…

- Determining whether a relation is a function.
- Apply mathematical properties to functions
- Representing relations using different formats
- Evaluating a function
- Writing function rules from tables and word problems
- Determining the domain and range of various functions
- Graphing absolute value functions with transformations.
- With technology, recognizing linear and quadratic functions given data and graphs.

● CCSS.HSF.BF.A.1: Write a function that describes a relationship between two quantities. ● CCSS.MP3: Construct viable arguments and critique the reasoning of others ● CCSS.MP7: Look for and make use of structure		
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1
Unit 4: Linear Systems

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solve linear systems using both graphic and algebraic methods.

Content Standards:

- CCSS.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- CCSS.HSA.REI.C.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- CCSS.HSA.REI.C.6: Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- CCSS.HSA.REI.D.12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP5 Use appropriate tools strategically.
- CCSS.MP6 Attend to precision.

Transfer

Students will be able to independently use their learning to…

- use their knowledge of linear systems to see the connection between an algebraic solution to a system of equations and the graphical picture of the solution.
- apply this knowledge with systems of higher order equations.

Meaning

ENDURING UNDERSTANDINGS

- There is more than one way to solve a system of equations. Based on the given information, there is a best method to use.
- Systems of equations can be used to solve real world problems.

ESSENTIAL QUESTIONS

- How do you solve real world problems using systems of equations?
- Which method is best and why?
- How can systems of equations be used to represent situations and solve problems?
- Why can a system of equations have none, one or infinitely many solutions?

Acquisition

Students will understand…

- systems of linear equations.
- the intersection point of two lines is the solution of the system
- systems of linear inequalities (2 variables)
- the overlapping shaded solution is the solution to the system of inequalities

Students will be skilled at…

- writing and solving linear systems by graphing, elimination, and substitution methods
- determining the most efficient method for solving a given system of equations
- distinguishing if a system of equations has one solution, no solution, or infinitely many solutions.
- creating and interpreting linear inequalities in one variable.
- graphing linear inequalities on a coordinate plane

● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning		● graphing systems of linear inequalities on a coordinate plane. ● modeling and solving real world situations with systems of equations.
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1
Unit 5: Polynomials

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will begin their study of polynomials.

- CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. CCSS.HSA.SSE.B.3.a: Factor a quadratic expression to reveal the zeros of the function it defines.
- CCSS.HSA.APR.A.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP2 Reason abstractly and quantitatively
- CCSS.MP7 Look for and make use of structure.

Transfer

Students will be able to independently use their learning to…

- manipulate polynomials by addition, subtraction, and multiplication of polynomials so that they can use this knowledge as a basis in a deeper exploration of quadratic functions.

Meaning

ENDURING UNDERSTANDINGS

- Exponent properties are the foundations for many algebraic concepts.
- There are many equivalent versions of polynomial expressions found by simplifying, adding, subtracting, multiplying, and factoring expressions.
- Very large and very small numbers can be represented efficiently using scientific notation.

ESSENTIAL QUESTIONS

- What characteristics of a polynomial determine how to factor it completely?
- What are the rules of exponents and how are they applied to simplify expressions?

Acquisition

Students will understand…

- polynomial, trinomial, and binomial
- degree and standard form of a polynomial
- properties of exponents
- negative exponents
- Operations with polynomials
- scientific notation
- quadratic equations
- greatest common factor
- factoring polynomials

Students will be skilled at…

- simplifying monomials using rules of exponents including zero power and negative exponents
- adding, subtracting, and multiplying polynomials.
- finding perimeter and area involving polynomials.
- factoring out GCF
- factoring trinomials with $a = 1$ and $a \neq 1$
- factoring binomials by difference of squares
- solving quadratic equations by factoring

		● multiplying and dividing numbers in scientific notation
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1
Unit 6: Radical Expressions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="2">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will begin their study of radical expressions.
● CCSS.HSA.SSE.A.2: Use the structure of an expression to identify ways to rewrite it.
● CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
● CCSS.HSG.SRT.C.8: Use... the Pythagorean Theorem to solve right triangles in applied problems.
● CCSS.HSN.RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.
● CCSS.MP7 Look for and make use of structure
● CCSS.MP8 Look for and express regularity in repeated reasoning</td><td colspan="2">Transfer
Students will be able to independently use their learning to…
● use their knowledge of simplifying radical expressions to solve applications based on the Pythagorean Theorem and as a basis for future explorations of radicals.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Radical expressions can be represented in different yet equivalent forms.</td><td>ESSENTIAL QUESTIONS
● How can simplifying radicals help us solve problems?</td></tr>
<tr><td rowspan="2">Used in Content Area Standards</td><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● Radical
● Pythagorean theorem
● Rationalization of denominators.</td><td>Students will be skilled at…
● simplifying radical expressions
● adding, subtracting, multiplying, and dividing radicals.
● solving problems involving the Pythagorean theorem.</td></tr>
<tr><td></td><td colspan="2">21st Century Skills</td></tr>
<tr><td></td><td colspan="2">● Collaboration
● Critical Thinking
● Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: CP Algebra 1

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Solving Equations and Inequalities	● Literal and algebraic equations ● Absolute value equations ● Percents ● Proportions ● Inequalities ● Compound inequalities ● Graphs of Linear inequalities ● algebraic proofs	● When solving equations, equality must be preserved by performing the same operations on both sides of an equation.. ● There are differences between solutions to inequalities and equations	● Write and solve multi-step equations with rational coefficients. ● Write and solve multi-step one variable inequalities, and graph them on a number line ● Solve and graph compound inequalities ● Solve absolute value equations ● Solve literal equations ● Write and solve proportions with binomials in the numerator or denominator ● Write and solve application percent problems ● Use properties to justify steps in solving equations ● Create and interpret linear inequalities in one variable
Unit 2: Linear Relationships	● Slope as rate of change ● Forms of linear equations ● Arithmetic sequences ● Direct variation ● Linear equation forms (Slope-intercept form, Point-slope form, standard form) ● Slopes of Parallel and perpendicular lines ● Properties of horizontal and vertical lines ● Scatterplots ● Line of best fit	● Linear relationships have a constant rate of change ● Tables, graphs, and equations are interconnected ways of representing functions and real world phenomena ● Visual displays can model data and be used to make predictions	● Calculate slope between two points ● Determine the slope of a line, given an equation, table, or graph ● Determine whether lines are parallel, perpendicular, or neither ● Find intercepts given graphs and equations ● Graph linear equations ● Write a rule given an arithmetic sequence ● Write equations of lines given specific characteristics ● Create and interpret linear equations from real world data ● Calculate the line of best fit ● Determine if there is a correlation between bivariate data ● Make predictions based on the line of best fit ● Use the line of best fit to find the starting point represented by the y-intercept and to describe the slope in context.

Unit 3: Foundation of Functions	● representations of relations (mapping, tables, graphs, equations) ● function and relation ● function notation. ● domain and range of a function	● Relations and functions can represent real world phenomena ● A function is a special relationship between values; each input value gives back exactly one output value.	● Determine whether a relation is a function ● Represent relations using different formats ● Write function rules from tables and word problems ● Determine the domain and range of various functions ● translate between verbal and algebraic expressions. ● Graph various functions (quadratic, cubic, absolute value, etc) using input/output tables.
Unit 4: Linear Systems	● Systems of equations ● Systems of inequalities ● Linear inequalities ● Intersection point of two lines is a solution of the system	● There is more than one way to solve a system of equations. Based on the given information, there is a best method to use. ● Systems of equations can be used to solve real world problems	● Write and solve linear systems by graphing, elimination, and substitution ● Determine the most efficient method for solving a given system of equations ● Distinguish if a system of equations has one solution, no solution, or infinitely many solutions ● Graph linear inequalities on a coordinate plane ● Solve systems of linear inequalities by graphing ● Model and solve real world situations with systems of equations ● model and solve real world situations with systems of linear inequalities including linear programming.
Unit 5: Polynomials	● Polynomial, trinomial, binomial ● Degree of polynomial ● Standard Form of polynomial ● Properties of exponents ● Polynomial factoring ● Scientific notation ● Quadratic equations ● Greatest common factor ● Negative exponents	● Exponent properties are the foundation for many algebraic concepts ● There are many equivalent versions of polynomial expressions found by simplifying, adding, subtracting, multiplying, and factoring expressions.	● Use the rules of exponents to simplify monomials ● Add, subtract, and multiply polynomials ● Find perimeter and area involving polynomials ● Factor polynomials by factoring out GCF ● Factor trinomials with a=1 and a $\neq$ 1. ● Factoring binomials by the difference of squares. ● Multiply and divide numbers in scientific notation ● Solve quadratic equations by factoring
Unit 6: Radical Expressions	● Radical ● Pythagorean theorem ● Rationalize Denominator	● Radical expressions can be represented in different yet equivalent forms.	● Simplify radicals ● Add, subtract, multiply, and divide radicals ● Solve problems involving the Pythagorean theorem

Windham School District Curriculum
CP Algebra 1
Unit 1: Solving Equations and Inequalities

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solidify their skills in solving advanced linear equations and inequalities.

Content Standards:

- CCSS.HSA.REI.10. Represent and solve equations and inequalities graphically. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane often forming a curve (which could be a line).
- CCSS.HSA.REI.12. Represent and solve equations and inequalities graphically. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- CCSS.HSA.CED.1. Create equations and inequalities in one variable and use them to solve problems.
- CCSS.HSA.REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CCSS.HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Transfer

Students will be able to independently use their learning to…

- fluently solve multi-step linear equations and use these skills in many applications as well as future mathematics classes.

Meaning

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
● When solving equations, equality must be preserved by performing the same operations on both sides of an equation. ● There are differences between solutions to inequalities and equations.	● How do you use equations to model real world problems? ● How can an equation or inequality be manipulated to isolate a variable while preserving the equality of the original equation/inequality?

Acquisition

Students will understand..	*Students will be skilled at…*
● literal and algebraic equations. ● absolute value equations. ● percents ● proportions ● inequalities ● compound inequalities. ● Graphs of Linear inequalities ● algebraic proofs	● writing and solving multistep equations with rational coefficients ● writing and solving multi-step one-variable inequalities and graph the solutions on a number line ● using properties to justify the steps in solving equations ● solving and graphing compound inequalities ● solving absolute value equations ● solving literal equations

● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● writing and solving proportions with binomials in the numerator and denominator. ● Solving application percent problems.
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra 1
Unit 2: Linear Relationships

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will explore linear relationships.

Content Standards:

- CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- CCSS.HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- CCSS.HSF.IF.C.7.A: Graph linear … functions and show intercepts....
- CCSS.HSF.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- CCSS.HSF.IF.C.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Transfer

Students will be able to independently use their learning to…

- see the connection between equations and graphs.
- use their knowledge of graphing lines and using tables to graph other functions.

Meaning

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
● Linear relationships have a constant rate of change. ● Tables, graphs, and equations are interconnected ways of representing functions and real world phenomena. ● Visual displays can model data and be used to make predictions.	● How can graphs be used to solve linear equations? ● How do you determine the appropriate form of an equation for a line when given specific characteristics? ● What is the relationship between slope and rate of change and how can each be used to solve real world problems?

Acquisition

Students will understand…	*Students will be skilled at…*
● slope as rate of change ● forms of linear equations ● arithmetic sequences ● direct variation ● equations of lines in slope-intercept form, point slope form, and standard form. ● slopes of lines that are perpendicular and parallel to a given point or line ● properties of horizontal and vertical lines. ● scatterplots	● calculating slope between two points. ● determining the slope of a line given an equation, table or graph. ● determining whether lines are parallel, perpendicular, or neither. ● finding intercepts given graphs and equations. ● graphing linear equations. ● writing a rule given an arithmetic sequence. ● writing equations of lines given specific characteristics.

● CCSS.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. CCSS.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). ● CCSS.HSF.LE.A.2: Construct linear... functions, including arithmetic...sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). ● CCSS.HSF.LE.A.1.B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. ● CCSS.HSF.LE.B.5: Interpret the parameters in a linear...function in terms of a context. ● CCSS.HSS.ID.B.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. CCSS.HSS.ID.B.6.c: Fit a linear function for a scatter plot that suggests a linear association.	● line of best fit ● linear inequality	● creating and interpreting linear equations from real world data. ● Calculating the line of best fit ● graphing linear inequalities on a coordinate plane ● Determining if there is a correlation between bivariate data ● making predictions based on the line of best fit ● Using the line of best fit to find the starting point represented by the y-intercept and to describe the slope in context.
Used in Content Area Standards		***21st Century Skills***
CCSS.MP4: Model with mathematics CCSS.MP7: Look for and make use of structure CCSS.MP5 Use appropriate tools strategically		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra 1
Unit 3: Foundations of Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will gain a deeper understanding of functions including functional notation.

Content Standards:

- CCSS.HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).
- CCSS.HSF.IF.A.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- CCSS.HSF.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- CCSS.HSF.IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- CCSS.HSF.BF.A.1: Write a function that describes a relationship between two quantities.

Transfer

Students will be able to independently use their learning to…

- apply their basic knowledge of functions when exploring linear, quadratic, and higher-order functions.

Meaning

ENDURING UNDERSTANDINGS

- Relations and functions can represent real world phenomena.
- A function is a special relationship between values; each input value gives back exactly one output value.

ESSENTIAL QUESTIONS

- When is a relation actually a function?
- How do relations and functions relate to real world problems?

Acquisition

Students will understand…

- representations of relations (mapping, tables, graphs, equations)
- function and relation
- function notation
- domain and range of a function

Students will be skilled at…

- Determining whether a relation is a function
- Representing relations using different formats
- Evaluating a function in function notation
- Writing function rules from tables and word problems
- Determining the domain and range of various functions.
- Graphing functions (linear, quadratic, cubic, absolute value etc) using input/output tables
- translating between verbal and algebraic expressions

Used in Content Area Standards	*21st Century Skills*
CCSS.MP3: Construct viable arguments and critique the reasoning of others CCSS.MP7: Look for and make use of structure	● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra 1
Unit 4: Linear Systems

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solve linear systems using both graphic and algebraic methods.

Content Standards:

- CCSS.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- CCSS.HSA.REI.C.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- CCSS.HSA.REI.C.6: Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- CCSS.HSA.REI.D.12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system

Transfer

Students will be able to independently use their learning to…

- use their knowledge of linear systems to see the connection between an algebraic solution to a system of equations and the graphical picture of the solution.
- apply this knowledge with systems of higher order equations.

Meaning

ENDURING UNDERSTANDINGS

- There is more than one way to solve a system of equations. Based on the given information, there is a best method to use.
- Systems of equations can be used to solve real world problems.

ESSENTIAL QUESTIONS

- How do you solve real world problems using systems of equations?
- Which method is best and why?
- How can systems of equations be used to represent situations and solve problems?
- Why can a system of equations have none, one or infinitely many solutions?

Acquisition

Students will understand…

- systems of linear equations.
- systems of linear inequalities
- the intersection point of two lines is the solution of the system

Students will be skilled at…

- writing and solving linear systems by graphing, elimination, and substitution methods
- determining the most efficient method for solving a given system of equations
- distinguishing if a system of equations has one solution, no solution, or infinitely many solutions.
- graphing systems of linear inequalities on a coordinate plane.

of linear inequalities in two variables as the intersection of the corresponding half-planes. ● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP5 Use appropriate tools strategically. ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning		● modeling and solving real world situations with systems of linear equations. ● modeling and solving real world situations with systems of linear inequalities including linear programming.
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra 1
Unit 5: Polynomials

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will begin their study of polynomials.

- CCSS.MP7 Look for and make use of structure CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. CCSS.HSA.SSE.B.3.a: Factor a quadratic expression to reveal the zeros of the function it defines.
- CCSS.HSA.APR.A.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP2 Reason abstractly and quantitatively
- CCSS.MP7 Look for and make use of structure.

Transfer

Students will be able to independently use their learning to…

- manipulate polynomials by addition, subtraction, and multiplication of polynomials so that they can use this knowledge as a basis in a deeper exploration of quadratic functions.

Meaning

ENDURING UNDERSTANDINGS

- Exponent properties are the foundations for many algebraic concepts.
- There are many equivalent versions of polynomial expressions found by simplifying, adding, subtracting, multiplying, and factoring expressions.

ESSENTIAL QUESTIONS

- What characteristics of a polynomial determine how to factor it completely?
- What are the rules of exponents and how are they applied to simplify expressions?

Acquisition

Students will understand…

- polynomial, trinomial, and binomial
- degree and standard form of a polynomial
- properties of exponents
- greatest common factor
- scientific notation
- negative exponents
- quadratic equations
- polynomial factoring

Students will be skilled at…

- simplifying monomials using rules of exponents including zero power and negative exponents
- adding, subtracting, and multiplying polynomials.
- finding perimeter and area involving polynomials.
- factoring out GCF
- factoring trinomials with a = 1 and a ≠ 1
- factoring binomials by difference of squares
- multiplying and dividing numbers in scientific notation
- solving quadratic equations by factoring.

Used in Content Area Standards	*21st Century Skills*
	● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra 1
Unit 6: Radical Expressions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="8">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will begin their study of radical expressions.
● CCSS.HSA.SSE.A.2: Use the structure of an expression to identify ways to rewrite it.
● CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
● CCSS.HSG.SRT.C.8: Use... the Pythagorean Theorem to solve right triangles in applied problems.
● CCSS.HSN.RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.
● CCSS.MP7 Look for and make use of structure
● CCSS.MP8 Look for and express regularity in repeated reasoning</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● use their knowledge of simplifying radical expressions to solve applications based on the Pythagorean Theorem and as a basis for future explorations of radicals.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Radical expressions can be represented in different yet equivalent forms.</td><td>ESSENTIAL QUESTIONS
● How can simplifying radicals help us solve problems?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● Radical
● Pythagorean theorem
● Rationalization of denominator.</td><td>Students will be skilled at…
● simplifying radical expressions
● adding, subtracting, multiplying, and dividing radicals.
● solving problems involving the Pythagorean theorem.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Collaboration
● Critical Thinking
● Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Algebra 1 - Extended (2+ year program)

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Expressions and Functions	● algebraic expressions ● Distributive Property ● Order of Operations ● Like and unlike terms ● Functions and function notation	● There is a specific order in which numerical calculations must be completed. ● The properties of integers apply to algebraic expressions ● A function is a special relationship between values; each input value gives back exactly one output value.	● Evaluate numerical expressions using order of operations ● Evaluate algebraic expressions by using the distributive property and combining like terms ● evaluate functions
Unit 2: Solving Equations and Inequalities	● Proportion ● Percents ● Discount, Tax, Tip ● equations ● inequalities ● absolute value equations	● An equation can be seen as a tool to find an unknown value. ● Proportional reasoning can be useful in solving real life situations. ● When solving equations, equality must be preserved. ● Proportional reasoning can be useful in solving real life situations.	● Solve one-step equations ● Solve two-step equations ● Solve equations using the distributive property ● Solve equations by combining like terms on both sides of the equal sign ● Determine if two ratios form a proportion. ● Solve equations involving proportional relationships ● Apply proportional reasoning to solve percent problems including discount, tax, and tip ● Use the concept of equations to solve real world applications ● Check answers by determining if an answer is reasonable ● Solve and graph on a number line one-step and two-step inequalities ● Solve absolute value equations
Unit 3: Linear Relationships	● Slope as a rate of change ● Slope-intercept, point-slope and standard forms of linear	● Linear relationships have a constant rate of change.	● calculate slope between two points. ● determine the slope of a line given an equation, table or graph.

	equation ● x-intercept ● y-intercept ● Properties of horizontal and vertical lines ● Scatterplots ● Linear regression equation ● Linear inequalities	● Tables, graphs, and equations are interconnected ways of representing functions and real world phenomena. ● Visual displays can model data and be used to make predictions.	● find intercepts given graphs and equations. ● graph linear equations in slope-intercept and standard form ● write equations of lines given slope and y-intercept and slope and a point ● calculate the line of best fit ● graph linear inequalities on a coordinate plane ● make predictions based on the line of best fit
Unit 4: Systems of Equations	● systems of linear equations. ● systems of linear inequalities ● the intersection point of two lines is the solution of the system	● There is more than one way to solve a system of equations. Based on the given information, there is a best method to use. ● Systems of equations can be used to solve real world problems.	● solve linear systems by graphing, elimination, and substitution methods ● determine the most efficient method for solving a given system of equations ● distinguish if a system of equations has one solution, no solution, or infinitely many solutions. ● graph systems of linear inequalities on a coordinate plane.
Unit 5: Polynomials	● polynomial, trinomial, and binomial ● degree and standard form of a polynomial ● operations with polynomials	● Exponent properties are the foundations for many algebraic concepts. ● There are many equivalent versions of polynomial expressions found by simplifying, adding, subtracting, and multiplying expressions.	● add, subtract, and multiply polynomials. ● find perimeter and area involving polynomials.

Windham School District Curriculum
Algebra 1 Extended (2+ Year Program)
Unit 1: Expressions & Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solidify their skills in simplifying expressions and evaluating functions.

Content Standards:

- CCSS.HSA.SSE.A.1.A Interpret parts of an expression, such as terms, factors, and coefficients.
- CCSS.8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions
  CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP3 Construct viable arguments and critique the reasoning of others
  CCSS.MP4 Model with mathematics
- CCSS.HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Transfer

Students will be able to independently use their learning to…

- use their knowledge of simplifying expressions when they solve equations
- use their skill of evaluating functions when they graph lines using a table of values

Meaning

ENDURING UNDERSTANDINGS

- There is a specific order in which numerical calculations must be completed.
- The properties of integers apply to algebraic expressions
- A function is a special relationship between values; each input value gives back exactly one output value.

ESSENTIAL QUESTIONS

- How are the mathematical operations connected?
- How are the operations and properties of real numbers related to polynomials?
- When is a relation actually a function?

Acquisition

Students will understand…

- order of operations
- algebraic expressions
- like and unlike terms
- distributive property
- functions
- function notation

Students will be skilled at…

- Using order of operations to evaluate a numerical expression
- Simplifying algebraic expressions using the distributive property and combining like terms
- Evaluating functions

● CCSS.HSF.IF.A.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.		
Used in Content Area Standards		***21st Century Skills***
		● Perseverance ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1 Extended (2+ Year Program)
Unit 2: Solving Equations & Inequalities

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solidify their skills in solving advanced linear equations and inequalities.

Content Standards:

- CCSS.MATH.CONTENT.HSA.CED.A.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.
- CCSS.HSA.REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CCSS.HSF.LE.A.1.B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- CCSS.7.RP.A.2 Recognize and represent proportional relationships between quantities.
- CCSS.7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
- CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP4 Model with mathematics

Transfer

Students will be able to independently use their learning to…

- fluently solve multi-step linear equations and inequalities

Meaning

ENDURING UNDERSTANDINGS

- When solving equations, equality must be preserved.
- There are differences between solutions to inequalities and equations.
- An equation can be seen as a tool to find an unknown value.
- Proportional reasoning can be useful in solving real life situations.

ESSENTIAL QUESTIONS

- How do you use equations to model real world problems?
- How can an equation or inequality be manipulated to isolate a variable while preserving the equality of the original equation/inequality?

Acquisition

Students will understand…

- algebraic equations
- percents
- proportions
- inequalities
- absolute value equations
- discount, tax and tip

Students will be skilled at…

- Solving one and two-step equations
- Solving multi-step equations using distributive property and with variables on both sides
- Solving proportions involving variables (monomial and binomial)
- Solving percent problems
- Solving one and two step inequalities and graphing the solutions on a number line
- Solving absolute value equations
- Determining if 2 ratios form a proportion

		● Using equations and proportions to solve real world applications.
Used in Content Area Standards		***21st Century Skills***
		● Perseverance ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1 Extended (2+ Year Program)
Unit 3: Linear Relationships

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will explore linear relationships.

- CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- CCSS.HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- CCSS.HSF.IF.C.7.A: Graph linear … functions and show intercepts....
- CCSS.HSF.IF.C.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
- CCSS.HSF.IF.C.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
- CCSS.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes

Transfer

Students will be able to independently use their learning to…

- see the connection between equations and graphs.
- use their knowledge of using tables to graph other functions.

Meaning

ENDURING UNDERSTANDINGS

- Linear relationships have a constant rate of change.
- Tables, graphs, and equations are interconnected ways of representing functions and real world phenomena.
- Visual displays can model data and be used to make predictions.

ESSENTIAL QUESTIONS

- How can graphs be used to solve linear equations?
- How do you determine the appropriate form of an equation for a line when given specific characteristics?
- What is the relationship between slope and rate of change and how can each be used to solve real world problems?

Acquisition

Students will understand…

- slope as rate of change
- forms of linear equations
- equations of lines in slope-intercept form, point slope form, and standard form.
- properties of horizontal and vertical lines.
- scatterplots
- line of best fit
- linear inequality
- x and y-intercepts

Students will be skilled at…

- calculating slope between two points.
- determining the slope of a line given an equation, table or graph.
- finding intercepts given graphs and equations.
- graphing linear equations in slope-intercept and standard form
- writing equations of lines given slope and y-intercept and slope and a point
- calculating the line of best fit

with labels and scales. CCSS.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). ● CCSS.HSF.LE.A.2: Construct linear... functions, including arithmetic...sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). ● CCSS.HSF.LE.A.1.B: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. ● CCSS.HSF.LE.B.5: Interpret the parameters in a linear...function in terms of a context. ● CCSS.HSS.ID.B.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. CCSS.HSS.ID.B.6.c: Fit a linear function for a scatter plot that suggests a linear association.		● graphing linear inequalities on a coordinate plane ● making predictions based on the line of best fit
Used in Content Area Standards		***21st Century Skills***
not applicable		● Perseverance ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1 Extended (2+ Year Program)
Unit 4: Systems of Equations

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will solve linear systems using both graphic and algebraic methods.

Content Standards:
● CCSS.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
● CCSS.HSA.REI.C.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
● CCSS.HSA.REI.C.6: Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
● CCSS.HSA.REI.D.12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● use their knowledge of linear systems to see the connection between an algebraic solution to a system of equations and the graphical picture of the solution</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● There is more than one way to solve a system of equations. Based on the given information, there is a best method to use.
● Systems of equations can be used to solve real world problems.</td><td>ESSENTIAL QUESTIONS
● How do you solve real world problems using systems of equations?
● Which method is best and why?
● How can systems of equations be used to represent situations and solve problems?
● Why can a system of equations have none, one or infinitely many solutions?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● systems of linear equations.
● systems of linear inequalities
● the intersection point of two lines is the solution of the system</td><td>Students will be skilled at…
● solving linear systems by graphing, elimination, and substitution methods
● determining the most efficient method for solving a given system of equations
● distinguishing if a system of equations has one solution, no solution, or infinitely many solutions.
● graphing systems of linear inequalities on a coordinate plane.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
	● Perseverance ● Communication

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra 1 Extended (2+ Year Program)
Unit 5: Polynomials

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal exploration of Algebra 1. In this unit, students will explore polynomials.
● CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
● CCSS.HSA.APR.A.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● manipulate polynomials by addition, subtraction, and multiplication of polynomials so that they can use this knowledge as a basis in a deeper exploration of quadratic functions.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Exponent properties are the foundations for many algebraic concepts.
● There are many equivalent versions of polynomial expressions found by simplifying, adding, subtracting, and multiplying expressions.</td><td>ESSENTIAL QUESTIONS
● What are the rules of exponents and how are they applied to simplify expressions?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● polynomial, trinomial, and binomial
● degree and standard form of a polynomial
● operations with polynomials</td><td>Students will be skilled at…
● adding, subtracting, and multiplying polynomials.
● finding perimeter and area involving polynomials.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Perseverance
● Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Honors Algebra 2

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Properties of Transformations and Functions	● Characteristics of a graph ● Function notation and composition ● Transformations of functions ● Piecewise functions ● Review of absolute value inequalities	● Relations, and functions can be described with tables, graphs, and equations to analyze patterns of change ● Relations and functions can be represented numerically, graphically, algebraically, and/or verbally ● Properties of functions and function operations are used to model and analyze real world applications and quantitative relationships	● Find the domain and range given a graph, equation, table, or mapping diagram ● Compose and combine all types of functions with add, subtract, and multiply ● Solve and graph absolute value inequalities ● Use transformations to graph absolute value and quadratic functions ● Describe transformations on any type of function ● Transform generic functions on the coordinate plane ● Graph piecewise functions ● Use a graphing calculator to model functions and their transformations ● Develop rules for transformations of functions given a variety of examples ● Explain the correspondence between verbal descriptions, equations, tables, and graphs of functions ● Recognize patterns of transformations of known functions and apply them to unknown functions
Unit 2: System of Equations and Inequalities	● Solutions to a system of nonlinear equations ● Solutions to a system of inequalities ● Solutions to a system of 3 equations ● Operations with matrices	● Systems of equations and inequalities can be used to model and solve problems ● Matrices can be used to model and solve systems of equations	● Solve a system of nonlinear equations graphically, or algebraically using elimination or substitution ● Write a system of equations/inequalities given a verbal description ● Solve a system of inequalities by graphing ● Solve a system of 2 quadratic functions ● Choose the most efficient method to solve a system, solve, and determine the reasonableness of the answer ● Solve a system of equations using matrices

			● Perform operations with matrices including addition, subtraction, scalar multiplication, and multiplication
Unit 3: Quadratics	● Complete the Square ● Properties and operations of complex numbers ● Quadratic formula ● Square root property ● Factoring quadratics ● Applications of quadratics ● Characteristics of a quadratic in vertex and standard form ● Quadratic equations and inequalities in many forms including graphs, tables, and equations ● The meaning of complex solutions	● The characteristics of quadratic functions and their representations are useful in solving real-world problems ● Imaginary numbers exist and can be used to describe solutions	● Identify the vertex, axis of symmetry, direction, maximum or minimum, x and y intercepts, domain and range of quadratics ● Write and graph quadratic equations in vertex and standard form ● Solve quadratics involving real and complex solutions by factoring, completing the square, square root property, and/or quadratic formula. ● Factor using GCF, difference of squares, sum/difference of cubes, leading coefficient not equal to 1, leading coefficient equal to 1 ● Choose the most efficient method to solve a quadratic, solve, and determine the reasonableness of the answer ● Model quadratic problems that arise in everyday life ● Write and solve applications of quadratic functions ● Use a graphing calculator to represent given quadratics ● Use a graphing calculator to compare linear, quadratic, and exponential growth ● Perform operations with complex numbers
Unit 4: Exponents and Polynomials	● Properties of exponents ● Synthetic division ● Long division ● Factors, roots, zeros	● There is an unique relationship between zeros and factors of polynomials	● Divide polynomials including synthetic and long division ● Determine the most-effective way to divide a polynomial based on if it is linear, coefficient #, quadratic, etc ● Perform arithmetic operations on polynomial ● Use the properties of exponents to transform expressions

			● Understand that a function models a relationship between two quantities by linking factors, zeros, and roots ● Sketch the graph of a polynomial function with zeros and end behavior ● Use a graphing calculator to represent given polynomials and analyze the graph
Unit 5: Radical and Rational Expressions and Equations	● Rational exponents ● Radical expressions and equations ● Rational expressions and equations ● The flexibility in process when simplifying radicals	● Corresponding to every power there is a root. ● Properties of real numbers can be used to simplify radicals. ● A radical expression has an equivalent form using a fractional exponent instead of a radical sign.	● Simplify expressions and solve equations with integer and rational exponents ● Simplify numeric and algebraic radical expression up to the 5^{th} degree ● Solve radical equations ● Solve basic exponential functions ● Add, subtract, multiply, divide, and simplify rational expressions ● Solve rational equations ● Convert between rational exponent and radical form
Unit 6: Sequences, Series, and Set Theory	● Arithmetic and geometric sequences ● Arithmetic and geometric series ● Set theory ● Venn Diagrams ● Relationships of sequences and series to functions	● Arithmetic and geometric series represent patterns and can be used to model real-life problems. ● Relationships can be represented using set theory.	● Draw and interpret Venn Diagrams to solve real life problems ● Create arithmetic, geometric, and other sequences and series to solve real life problems. ● Identify and describe sets, subsets, complements, unions, and intersections of sets
Unit 7: Logarithmic and Exponential Functions	● Logarithmic functions ● Exponential functions ● Logarithmic and exponential application problems ● Relationship between exponential and logarithmic functions.	● Logarithms and exponents have corresponding properties. ● The function $y = e^x$ and $y = \ln x$ are inverse functions.	● Solve application problems using exponential and logarithmic functions including: appreciation, depreciation, compound interest, half-time, and double-time problems. ● Apply the power, quotient, and product properties of logarithms. ● Solve logarithmic equations. ● Explain the relationship between exponential and logarithmic functions

Windham School District Curriculum
Honors Algebra II
Unit 1: Properties & Transformations of Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore the graphs and properties of different functions.

Content Standards:

- CCSS.HSF.IF.A.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- CCSS.HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). CCSS.HSF.IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- CCSS.HSF.IF.C.7.B: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- CCSS.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); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Transfer

Students will be able to independently use their learning to…

- graph any new function by creating tables and understanding the properties of transformations
- use functions to simulate the world we live in

Meaning

ENDURING UNDERSTANDINGS

- Relations, and functions can be described with tables, graphs, and equations to analyze patterns of change.
- Relations and functions can be represented numerically, graphically, algebraically, and/or verbally.
- Properties of functions and function operations are used to model and analyze real world applications and quantitative relationships.

ESSENTIAL QUESTIONS

- How are functions used to represent/simulate the world we live in, and why are they so important?
- How do multiplying and/or adding a constant to a function change the graph?

Acquisition

Students will understand…

- the characteristics of a graph
- function notation and composition of a function
- transformations
- piecewise functions.

Students will be skilled at…

- finding the domain and range given a graph, equation, table, or mapping diagram.

Include recognizing even and odd functions from their graphs and algebraic expressions for them. ○ CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. CCSS.HSF.IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* ● CCSS.HSF.BF.A.1: Write a function that describes a relationship between two quantities.* ● CCSS.HSF.BF.A.1.B: Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. ● CCSS.HSF.BF.A.1.C: (+) Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time. ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision	● absolute value inequalities.	● combining all types of functions with addition, subtraction, and multiplication. ● creating new functions by composition of functions ● solving and graphing absolute value inequalities on a number line. ● using transformations to graph quadratic and absolute value functions. ● describing transformations on any type of function. ● transforming generic functions on the coordinate plane. ● graphing piecewise functions ● explaining the correspondence between verbal descriptions, equations, tables, and graphs of functions. ● utilizing a graphing calculator or other technology to model functions and their transformations. ● recognizing patterns of transformations of known functions and applying them to unknown functions. ● developing rules for transformations of functions given a variety of examples and applying those rules to other functions.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Algebra II
Unit 2: Systems of Equations & Inequalities

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students graph and solve systems of linear and nonlinear equations and inequalities.

Content Standards:

- CCSS.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- CCSS.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods*.
- CCSS.HSA.REI.C.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- CCSS.HSA.REI.C.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x2 + y2 = 3$.
- CCSS.HSA.REI.D.11: Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are

Transfer

Students will be able to independently use their learning to…

- see the usefulness of systems of equations and inequalities.
- understand the situations that could be represented by a system of equations or inequalities instead of a single equation or inequality.

Meaning

ENDURING UNDERSTANDINGS

- Systems of equations and inequalities can be used to model and solve problems.
- Matrices can be used to model and solve systems of equations.

ESSENTIAL QUESTIONS

- How are systems of equations and inequalities useful?
- What situations would be represented by a system of equations or inequalities instead of a single equation or inequality?

Acquisition

Students will understand…

- the types of solutions possible for a system of inequalities.
- systems of nonlinear equations
- systems of equations with 3 variables
- matrices

Students will be skilled at…

- solving a system of linear and/or nonlinear equations graphically and algebraically
- solving a system of 2 quadratic functions
- solving a system of inequalities by graphing
- choosing the most efficient method to solve systems

linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* ● CCSS.HSA.REI.D.12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP6 Attend to precision		● determining the reasonableness of the answer and, if needed, determining another answer ● writing a system of equations and inequalities given a verbal description ● solving a system of equations using matrices ● perform operations with matrices including addition, subtraction, scalar multiplication, and multiplication
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Algebra II
Unit 3: Quadratics

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore all aspects of the quadratic function including graphing and finding the zeros of the function as well learn about the larger number system known as the complex number system.

Content Standards:

- CCSS.HSA.SSE.A.2: Use the structure of an expression to identify ways to rewrite it.
- CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
- CCSS.HSA.SSE.B.3.A: Factor a quadratic expression to reveal the zeros of the function it defines. CCSS.HSA.SSE.B.3.B: Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
- CCSS.HSA.REI.B.4: Solve quadratic equations in one variable.
- CCSS.HSA.REI.B.4.A: Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form (*x* - *p*)2 = *q* that has the same solutions. Derive the quadratic formula from this form. CCSS.HSA.REI.B.4.B: Solve quadratic equations by inspection (e.g., for *x*2 = 49), taking square roots, completing the square, the quadratic formula and

Transfer

Students will be able to independently use their learning to…

- explain the significance of the complex number system
- more thoroughly explain connections graphs and equations of functions through the quadratic function
- apply their knowledge of quadratic functions when solving real world application problems

Meaning

ENDURING UNDERSTANDINGS

- The characteristics of quadratic functions and their representations are useful in solving real-world problems.
- Imaginary numbers exist and can be used to describe solutions.

ESSENTIAL QUESTIONS

- How can we use the quadratic formula to solve real world application problems?
- What is an imaginary number and what is its value?
- How does factoring and finding roots of a quadratic give me solutions to application problems?

Acquisition

Students will understand…

- quadratic equations and inequalities in many forms including graphs, tables, and equations
- characteristics of a quadratic function in both standard and vertex form

Students will be skilled at…

- identifying the vertex, axis of symmetry, direction, maximum or minimum, x and y intercepts, domain and range of quadratics.
- writing and graphing quadratic equations in vertex and standard form.

factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. ● CCSS.HSF.IF.C.7.A: Graph linear and quadratic functions and show intercepts, maxima, and minima. CCSS.HSF.IF.C.8.A: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. ● CCSS.HSN.CN.A.1: Know there is a complex number i such that $i2 = -1$, and every complex number has the form $a + bi$ with a and b real. ● CCS.HSN.CN.A.2: Use the relation $i2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. ● CCSS.HSN.CN.A.3: (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. ● CCSS.HSN.CN.B.5: (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. ● CCS.HSN.CN.C.7: Solve quadratic equations with real coefficients that have complex solutions. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP4 Model with mathematics ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning	● the algebraic methods of factoring, square root property, and the quadratic formula. ● quadratics model everyday situations ● the formulas for real world quadratic application ● properties of complex numbers ● the meaning of complex solutions. ● completing the square	● solving quadratics involving real and complex solutions by factoring, completing the square, using the square root property, and using the quadratic formula. ● factoring by using GCF, difference of squares, sum/difference of cubes, trinomails with leading coefficient ≠1, and trinomials with leading coefficient =1. ● choosing the most efficient and effective method to solve quadratics. ● determining the reasonableness of the answer and, if needed, finding another solution ● modeling quadratic problems that arise in everyday life ● using a graphing calculator or other technology to represent quadratics ● using a graphing calculator to compare linear, quadratic, and exponential growth. ● performing operations with complex numbers. ● writing and solving applications of quadratic functions
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Algebra II
Unit 4: Exponents & Polynomials

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students expand their understanding of polynomial operations, functions, and graphs.

Content Standards:

- CCSS.HSA.APR.A.1: Understand that polynomials form a system analogous to the integers; namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- CCSS.HSA.APR.B.2: Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
- CCSS.HSA.APR.D.6: Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$,
- where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
- CCSS.HSF.IF.C.7.C: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP2 Reason abstractly and quantitatively
- CCSS.MP5 Use appropriate tools strategically
- CCSS.MP6 Attend to precision

Transfer

Students will be able to independently use their learning to…

- more thoroughly explain connections graphs and equations of functions through the generic polynomial function

Meaning

ENDURING UNDERSTANDINGS

- There is an unique relationship between zeros and factors of polynomials

ESSENTIAL QUESTIONS

- How do factoring and finding roots of a polynomial yield solutions to application problems?

Acquisition

Students will understand…

- properties of exponents.
- synthetic division.
- polynomial long division.
- the relationship between factors, roots, and zeros.

Students will be skilled at…

- dividing polynomials using both synthetic and long division.
- using the properties of exponents fluently to transform expressions.
- determining the most effective way to divide a polynomial based on if it is linear, coefficient ≠1, quadratic, etc.
- modeling a function's relationship between two quantities by linking factors, zeros, and roots.

		● using a graphing calculator or other technology to represent and analyze polynomial functions ● sketch the graph of a polynomial function with zeros and end behavior
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Algebra II
Unit 5: Radical & Rational Expressions & Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore the connections between radical expressions and expressions with rational exponents as well as solve radical equations.

Content Standards:

- CCSS.HSA.APR.D.7: (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
- CCSS.HSA.REI.A.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. CCSS.HSN.RN.A.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5.
- CCSS.HSN.RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of

Transfer

Students will be able to independently use their learning to…

- explain the connections and differences between integer exponents and rational exponents
- solve problems using their knowledge of solving radical equations

Meaning

ENDURING UNDERSTANDINGS

- Corresponding to every power there is a root.
- Properties of real numbers can be used to simplify radicals.
- A radical expression has an equivalent form using a fractional exponent instead of a radical sign.

ESSENTIAL QUESTIONS

- How can we make sense of exponents that are not integers?
- Why do rational equations sometimes have extraneous solutions?

Acquisition

Students will understand…

- rational exponents.
- radical and rational expressions
- the flexibility in process when simplifying radicals
- solutions to radical and rational equations.

Students will be skilled at…

- simplifying expressions with integer and rational exponents
- solving equations with integer and rational exponents
- simplifying numeric and algebraic radical expressions up to the 5th degree
- solving radical equations
- solving basic exponential functions.

exponents. CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● adding, subtracting, multiplying, dividing and simplifying rational expression ● solving rational equations ● converting between rational exponent and radical form
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Algebra II
Unit 6: Sequences, Series, and Set Theory

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore sequences and series with emphasis on arithmetic and geometric sequences.

Content Standards:

- CCSS.HSF.IF.A.3: Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1*.
  CCSS.HSF.BF.A.2: Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- CCSS.HSA.SSE.B.4: Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments**
- CCSS.MP2 Reason abstractly and quantitatively
- CCSS.MP4 Model with mathematics

Transfer

Students will be able to independently use their learning to…

- recognize arithmetic and geometric sequences within real-life data
- Determine patterns in data

Meaning

ENDURING UNDERSTANDINGS

- Arithmetic and geometric series represent patterns and can be used to solve real-life problems.
- Relationships can be represented using set theory.

ESSENTIAL QUESTIONS

- What situations require arithmetic sequences versus geometric sequences?
- How does set theory help to identify relationships and solve problems?

Acquisition

Students will understand…

- the relationship of arithmetic sequences to linear functions
- the relationship of geometric series to exponential functions.
- the terms and sums of arithmetic and geometric series.
- set theory.
- Venn Diagrams.

Students will be skilled at…

- drawing and interpreting Venn Diagrams to solve real life problems.
- creating arithmetic, geometric, and other sequences and series to solve real life problems.
- identifying and describing sets, subsets, complements, unions, and intersections of sets.

Used in Content Area Standards	*21st Century Skills*
not applicable	● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Algebra II
Unit 7: Logarithmic & Exponential Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore the basics of logarithmic and exponential functions.

Content Standards:

- CCSS.HSF.BF.B.5: (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- CCSS.HSF.LE.A.4: For exponential models, express as a logarithm the solution to *abct = d* where *a*, *c*, and *d*are numbers and the base *b* is 2, 10, or *e*; evaluate the logarithm using technology.
- CCSS.HSA.SSE.B.3.C: Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as (1.151/12)12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%*.
- CCSS.HSF.IF.C.8.B: Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay.
- CCSS.MP4 Model with mathematics

Transfer

Students will be able to independently use their learning to…

- recognize real-life applications of exponential functions
- apply knowledge of solving exponential and logarithmic functions when solving problems
- increase knowledge of inverse functions through an understanding of the connection between logarithmic and exponential functions

Meaning

ENDURING UNDERSTANDINGS

- Logarithms and exponents have corresponding properties.
- The function $y = e^x$ and $y = \ln x$ are inverse functions.

ESSENTIAL QUESTIONS

- How can we solve real world application problems using exponential and logarithmic functions?
- How are logarithmic and exponential functions related?

Acquisition

Students will understand…

- the relationship between logarithmic functions and exponential functions.
- basic properties of logarithms
- logarithmic equations

Students will be skilled at…

- solving application problems using exponential and logarithmic functions
- applying the power, quotient, and product properties of logarithms
- solving logarithmic equations
- explaining relationships between exponential and logarithmic functions

● CCSS.MP8 Look for and express regularity in repeated reasoning		
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: CP Algebra 2

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Properties of Transformations and Functions	● Characteristics of a graph ● Function notation and composition ● Transformations ● Piecewise functions	● Relations, and functions can be described with tables, graphs, and equations to analyze patterns of change ● Relations and functions can be represented numerically, graphically, algebraically, and/or verbally ● Properties of functions and function operations are used to model and analyze real world applications and quantitative relationships	● Find the domain and range given a graph, equation, table, or mapping diagram ● Compose and combine all types of functions ● graph absolute value inequalities ● Describe transformations on any type of function ● Transform generic functions on the coordinate plane ● Graph piecewise functions ● Explain the correspondence between verbal descriptions, equations, tables, and graphs of functions ● Recognize patterns of transformations of known functions and apply them to unknown functions ● Develop rules for transformations of functions given a variety of examples and applying those rules to other functions ●
Unit 2: System of Equations and Inequalities	● Solution(s) to a system of nonlinear equations ● Solution(s) to a system of 3 equations	● Systems of equations and inequalities can be used to model and solve problems	● Solve a system of nonlinear equations graphically and algebraically ● Solve a system of 3 linear equations ●
Unit 3: Quadratics	● Complete the Square ● Characteristics of a quadratic in both vertex and standard form ● Properties and operations of complex numbers ● Quadratic formula ● Square root property ● Factoring quadratics	● The characteristics of quadratic functions and their representations are useful in solving real-world problems ● Imaginary numbers exist and can be used to describe solutions	● Identify the vertex, axis of symmetry, direction, maximum or minimum, x and y intercepts, domain and range of quadratic functions ● Write and graph quadratic equations in vertex and standard form ● Solve quadratics by factoring, square root, and/or quadratic formula ● Determine most effective method for solving a

	● Transformations of $f(x) = x^2$ ● Quadratic equations and inequalities in many forms including graphs, tables, and equations ● Quadratics model everyday life		quadratic equation ● Factor using GCF, difference of squares, leading coefficient not equal to 1, leading coefficient equal to 1 ● Model quadratic problems that arise in everyday life. ● Complete the square to convert to vertex form ● Use transformations to graph quadratic functions ● Perform operations with complex numbers ● Determine reasonableness of an answer
Unit 4: Exponents and Polynomials	● Properties of exponents ● Synthetic division ● Long division ● Factors, roots, zeros	● There is an unique relationship between zeros and factors of polynomials	● Divide polynomials including synthetic and long division ● Perform arithmetic operations on polynomials ● Use the properties of exponents to transform expressions ● Understand that a function models a relationship between two quantities by linking factors, zeros, and roots ● Sketch graph of a polynomial function with zeros and correct end behavior.
Unit 5: Radical and Rational Expressions and Equations	● Rational exponents ● Radical and rational expressions ● Rational and radical equations	● Corresponding to every power there is a root. ● Properties of real numbers can be used to simplify radicals. ● A radical expression has an equivalent form using a fractional exponent instead of a radical sign.	● Simplify expressions and solve equations with integer and rational exponents ● Simplify numeric and algebraic radical expression up to the 3rd degree ● Solve radical equations ● Solve basic exponential functions ● Add, subtract, multiply, divide, and simplify rational expressions ● Solve rational equations ● Convert between rational exponent and radical form

Windham School District Curriculum
CP Algebra II
Unit 1: Properties of Transformations & Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore the graphs and properties of different functions.

Content Standards:

- CCSS.HSF.IF.A.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- CCSS.HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*).
- CCS.HSF.IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- CCSS.HSF.IF.C.7.B: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- CCSS.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); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Transfer

Students will be able to independently use their learning to…

- graph any new function by creating tables and understanding the properties of transformations
- use functions to simulate the world we live in

Meaning

ENDURING UNDERSTANDINGS

- Relations, and functions can be described with tables, graphs, and equations to analyze patterns of change.
- Relations and functions can be represented numerically, graphically, algebraically, and/or verbally.
- Properties of functions and function operations are used to model and analyze real world applications and quantitative relationships.

ESSENTIAL QUESTIONS

- How are functions used to represent/simulate the world we live in, and why are they so important?
- How do multiplying and/or adding a constant to a function change the graph?

<table>
<tr><td rowspan="2">

CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
CCSS.HSF.IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases* and using technology for more complicated cases.
CCSS.HSF.BF.A.1: Write a function that describes a relationship between two quantities*
CCSS.HSF.BF.A.1.B: Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.
CCSS.HSF.BF.A.1.C: (+) Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.
CCSS.MP1 Make sense of problems and persevere in solving them.
CCSS.MP2 Reason abstractly and quantitatively.
CCSS.MP3 Construct viable arguments and critique the reasoning of others.
CCSS.MP4 Model with mathematics.
CCSS.MP5 Use appropriate tools strategically.
CCSS.MP6 Attend to precision.

</td><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
characteristics of a graph.
function notation
composition of functions
transformations
piecewise functions</td><td>Students will be skilled at…
finding the domain and range given a graph, equation, table, or mapping diagram.
composing and combining all types of functions using addition, subtraction, and multiplication.
graphing absolute value inequalities
recognizing functional notation and evaluating functions.
describing transformations on any type of function.
transforming generic functions on the coordinate plane.
graphing piecewise functions.
explaining the correspondence between verbal descriptions, equations, tables, and graphs of functions.
recognizing patterns of transformations of known functions and applying them to unknown functions.
developing rules for transformations of functions given a variety of examples and applying those rules to other functions.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>Collaboration
Critical Thinking
Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum

CP Algebra II

Unit 2: System of Equations & Inequalities

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="8">ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students graph and solve systems of linear and nonlinear equations.

Content Standards:
● CCSS.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
● CCSS.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
● CCSS.HSA.REI.C.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
● CCSS.HSA.REI.C.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● see the usefulness of systems of equations and inequalities.
● understand the situations that could be represented by a system of equations instead of a single equation.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Systems of equations and inequalities can be used to model and solve problems.</td><td>ESSENTIAL QUESTIONS
● How are systems of equations and inequalities useful?
● What situations would be represented by a system of equations or inequalities instead of a single equation or inequality?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● system of nonlinear equations.
● system of equations with 3 variables.</td><td>Students will be skilled at…
● solving a system of 3 linear equations algebraically
● solving a system of nonlinear equations algebraically and graphically</td></tr>
</table>

● algebraically and graphically. For example, find the points of intersection between the line y = -3x and the circle x2 + y2 = 3. ● CCSS.HSA.REI.D.11: Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x)intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear,*polynomial, rational, absolute value, exponential, and logarithmic functions. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP6 Attend to precision		
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra II
Unit 3: Quadratics

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore all aspects of the quadratic function including graphing and finding the zeros of the function as well learn about the larger number system known as the complex number system.

Content Standards:

- CCSS.HSA.SSE.A.2: Use the structure of an expression to identify ways to rewrite it.
- CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression*
- CCSS.HSA.SSE.B.3.A: Factor a quadratic expression to reveal the zeros of the function it defines.
- CCSS.HSA.REI.B.4: Solve quadratic equations in one variable.
- CCSS.HSA.REI.B.4.B: Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.
- CCSS.HSF.IF.C.7.A: Graph linear and quadratic functions and show intercepts, maxima, and minima.
- CCSS.HSF.IF.C.8.A: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Transfer

Students will be able to independently use their learning to…

- explain the significance of the complex number system
- more thoroughly explain connections graphs and equations of functions through the quadratic function
- apply their knowledge of quadratic functions when solving real world application problems

Meaning

ENDURING UNDERSTANDINGS

- The characteristics of quadratic functions and their representations are useful in solving real-world problems.
- Imaginary numbers exist and can be used to describe solutions.

ESSENTIAL QUESTIONS

- How can we use the quadratic formula to solve real world application problems?
- What is an imaginary number and what is its value?
- How does factoring and finding roots of a quadratic lead to solutions in application problems?

Acquisition

Students will understand…

- quadratic equations and inequalities in many forms including graphs, tables, and equations
- characteristics of a quadratic function in both standard and vertex form

Students will be skilled at…

- identifying the vertex, axis of symmetry, direction, maximum or minimum, x and y intercepts, domain and range of quadratic functions.
- writing and graphing quadratic equations in vertex and standard form.

● CCSS.HSN.CN.A.1: Know there is a complex number i such that i2 = -1, and every complex number has the form a + ● bi with a and b real. ● CCSS.HSN.CN.A.2: Use the relation i2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. ● CCSS.HSN.CN.A.3: (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. ● CCSS.HSN.CN.B.5: (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. ● CCSS.HSN.CN.C.7: Solve quadratic equations with real coefficients that have complex solutions. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP4 Model with mathematics ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning	● the algebraic methods of factoring, square root property, and the quadratic formula. ● quadratics model everyday situations ● properties and operations of complex numbers ● completing the square	● factoring using GCF, difference of squares, leading coefficient ≠1, and leading coefficient =1. ● solving quadratics by factoring, square root, and/or quadratic formula. ● completing the square to convert to vertex form ● using transformations to graph quadratic functions. ● modeling quadratic problems that arise in everyday life. ● performing operations with complex numbers. ● choosing the most efficient method to solve a quadratic ● determining the reasonableness of the answer
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra II
Unit 4: Exponents & Polynomials

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students expand their understanding of polynomial operations, functions, and graphs.

Content Standards:

- CCSS.HSA.APR.A.1: Understand that polynomials form a system analogous to the integers; namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- CCSS.HSA.APR.B.2: Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x - a is p(a), so p(a) = 0 if and only if (x - a) is a factor of p(x).
- CCSS.HSA.APR.D.6: Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x),
- where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
- CCSS.HSF.IF.C.7.C: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Transfer

Students will be able to independently use their learning to…

- more thoroughly explain connections graphs and equations of functions through the generic polynomial function

Meaning

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
● There is an unique relationship between zeros and factors of polynomials	● How do factoring and finding roots of a polynomial yield solutions to application problems?

Acquisition

Students will understand…	*Students will be skilled at…*
● properties of exponents. ● synthetic division. ● long division. ● factors, roots, and zeros.	● dividing polynomials including synthetic and long division. ● performing arithmetic operations on polynomials. ● using the properties of exponents to transform expressions. ● understanding that a function models a relationship between two quantities by linking factors, zeros, and roots. ● sketching graph of a polynomial function with zeros and correct end behavior.

Used in Content Area Standards	*21st Century Skills*
CCSS.MP1 Make sense of problems and persevere in solving them CCSS.MP2 Reason abstractly and quantitatively CCSS.MP5 Use appropriate tools strategically CCSS.MP6 Attend to precision	● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Algebra II
Unit 5: Radical & Rational Expressions & Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra. In this unit, students explore the connections between radical expressions and expressions with rational exponents as well as solve radical equations.

Content Standards:

- CCSS.HSA.APR.D.7: (+) Understand that rational expressions form a system analogous to the rational numbers, closed under
- addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
- CCSS.HSA.REI.A.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- CCSS.HSN.RN.A.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5(^{1/3})^3$ to hold, so $(5^{1/3})^3$ must equal 5.

Transfer

Students will be able to independently use their learning to…

- explain the connections and differences between integer exponents and rational exponents
- solve problems using their knowledge of solving radical equations

Meaning

ENDURING UNDERSTANDINGS

- Corresponding to every power there is a root.
- Properties of real numbers can be used to simplify radicals.
- A radical expression has an equivalent form using a fractional exponent instead of a radical sign.

ESSENTIAL QUESTIONS

- How can we make sense of exponents that are not integers?
- Why do rational equations sometimes have extraneous solutions?

Acquisition

Students will understand…

- rational exponents
- radical and rational expressions
- rational and radical equations

Students will be skilled at…

- simplifying expressions and solving equations with integer and rational exponents.
- simplifying numeric and algebraic radical expressions up to the 3rd degree.
- solving radical equations.
- solving basic exponential functions.
- adding, subtracting, multiplying, dividing and simplifying rational expressions.
- solving rational equations.
- converting between rational exponent and radical form.

● CCSS.HSN.RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning.		
Used in Content Area Standards		***21st Century Skills***
		● Collaboration ● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Algebra 2 Part A

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Review of Linear Relations and Functions	● Properties of equality ● Absolute value equations ● Linear inequalities ● Compound inequalities ● Absolute value inequalities ● Linear equations and graphs in slope intercept form, point slope form, and standard form	● Linear functions can be used to describe, interpret, and predict real world phenomena. ● Tables, graphs, and equations are ways for depicting and analyzing patterns of change in data. ● Linear relationships have a constant rate of change.	● Solve equations, inequalities, compound inequalities, and absolute value inequalities ● Graph linear equations. ● Write equations of lines in slope-intercept, point-slope, and standard forms ● Calculate the rate of change and its associated meaning ● Graph absolute value inequalities on a number line
Unit 2: Properties of Transformations and Functions	● Characteristics of a graph ● Function notation and composition ● Transformations of $f(x) = x^2$ ● Transformations of $f(x) = \lvert x \rvert$ ● Piecewise functions	● Relations, and functions can be described with tables, graphs, and equations to analyze patterns of change. ● Relations and functions can be represented numerically, graphically, algebraically, and/or verbally. ● Properties of functions and function operations are used to model and analyze real world applications and quantitative relationships.	● Find the domain and range given a graph, equation, table, or mapping diagram ● Compose and combine all types of functions ● Recognize function notation and evaluate functions. ● Recognize a graph by its characteristics. ● Use transformations to graph quadratic and absolute value functions ● Graph piecewise functions ● Utilize graphing technology to model functions and their transformations ● Describe transformations on quadratic and absolute value functions ● Attend to precision when graphing transformations by hand
Unit 3: Quadratics	● Vertex form ● Standard form ● Characteristics of a quadratic ● Properties and operations of complex numbers ● Quadratic formula ● Square root property	● The characteristics of quadratic functions and their representations are useful in solving real-world problems ● Imaginary numbers exist and can be used to describe solutions	● Identify the vertex, axis of symmetry, direction, maximum or minimum, x and y intercepts, domain and range ● Write and graph quadratic equations in vertex and standard form

	● Factoring quadratics ● Applications of quadratics		● Solve quadratics involving real and complex solutions by factoring, square root property, and/or quadratic formula ● Factor using GCF, difference of squares, leading coefficient not equal to 1, leading coefficient equal to 1 ● Identify characteristics of a quadratic function ● Compare vertex and standard form of a quadratic function ● Choose the most efficient method to solve a quadratic, solve, and determine the reasonableness of the answer ● Write and solve applications of quadratic functions ● Perform basic operations of complex numbers
Unit 4: System of Equations and Inequalities	● Solution(s) to a system of equations ● Solution(s) to a system of inequalities ● Linear programming (optimization problems)	● Systems of equations and inequalities can be used to model and solve problems	● Solve a system of linear equations graphically, or algebraically using elimination or substitution ● Write a system of equations/inequalities given a verbal description ● Solve a system of inequalities by graphing ● Choose the most efficient method to solve a system, solve, and determine the reasonableness of the answer ● Write and graph constraints using a linear programming model, and analyze the graph to find solutions

Windham School District Curriculum
Algebra II Part A
Unit 1: Review of Linear Relations & Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part A encompasses the first 2 semesters.. In this unit, students will review solving and graphing linear equations and inequalities.

Content Standards:

- CC.9-12.A.REI.3. Solve equations and inequalities in one variable. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- CC.9-12.A.REI.10. Represent and solve equations and inequalities graphically. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
  CC.9-12.A.REI.11. Represent and solve equations and inequalities graphically. Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational,

Transfer

Students will be able to independently use their learning to…

- fluently solve multi-step linear equations
- use their knowledge of solving linear equations as a tool for solving quadratic equations.
- use their knowledge of graphing linear equations to recognize when real-life data is a linear set of data

Meaning

ENDURING UNDERSTANDINGS

- Linear functions can be used to describe, interpret, and predict real world phenomena.
- Tables, graphs, and equations are ways for depicting and analyzing patterns of change in data.
- Linear relationships have a constant rate of change.

ESSENTIAL QUESTIONS

- How do you solve real world applications using linear equations, inequalities, and compound inequalities?
- What information do you need to calculate the rate of change?

Acquisition

Students will understand…

- the properties of equality.
- absolute value equations.
- linear inequalities, compound inequalities, and absolute value inequalities.
- linear equations and graphs in slope intercept form, point slope form, and standard form.

Students will be skilled at…

- Solving equations,absolute value equations, inequalities, compound inequalities, and absolute value inequalities.
- Writing equations of lines in slope-intercept, point-slope, and standard forms.
- Calculating the rate of change and its associated meaning.
- Graphing linear equations.

absolute value, exponential, and logarithmic functions. ● CC.9-12.A.REI.12. Represent and solve equations and inequalities graphically. Graph the solutions to a linear inequality in two variables and half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. ● CC.9-12.A.CED.1. Create equations that describe numbers or relationships, create equations inequalities in one variable and use them to solve problems. ● CC.9-12.A.CED.2. Create equations that describe numbers or relationships. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.		● Graphing absolute value inequalities on a number line.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Perseverance

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra II Part A
Unit 1: Properties & Transformations of Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part A encompasses the first 2 semesters.. In this unit, students will explore the properties and graphs of a variety of functions.

Content Standards:

- CCSS.HSF.IF.A.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- CCSS.HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*). CCSS.HSF.IF.B.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- CCSS.HSF.IF.C.7.B: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- CCSS.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); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects

Transfer

Students will be able to independently use their learning to…

- graph any new function by creating tables and understanding the properties of transformations
- use functions to simulate the world we live in

Meaning

ENDURING UNDERSTANDINGS

- Relations, and functions can be described with tables, graphs, and equations to analyze patterns of change.
- Relations and functions can be represented numerically, graphically, algebraically, and/or verbally.
- Properties of functions and function operations are used to model and analyze real world applications and quantitative relationships.

ESSENTIAL QUESTIONS

- How are functions used to simulate the world we live in?
- How does changing the function affect the graph?

Acquisition

Students will understand…

- Characteristics of a graph.
- Function notation and composition.

Students will be skilled at…

- finding the domain and range given a graph, equation, table, or mapping diagram.

on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. ● CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. CCSS.HSF.IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases* ● CCSS.HSF.BF.A.1: Write a function that describes a relationship between two quantities* ● CCSS.HSF.BF.A.1.B: Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model*. ● CCSS.HSF.BF.A.1.C: (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time*. ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision	● Transformations of $f(x)=x^2$ and $f(x)=\|x\|$. ● Piecewise functions.	● composing and combining all types of functions using addition and subtraction ● recognizing function notation ● evaluating functions ● recognizing a graph by its characteristics. ● using transformations to graph quadratic and absolute value functions. ● describing transformations on quadratic and absolute value functions. ● transforming functions on the coordinate plane. ● graphing piecewise functions. ● utilizing graphing technology to model functions and their transformations. ● attending to precision when graphing transformations by hand. ● recognizing patterns of transformations of known functions and applying them to unknown functions.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra II Part A
Unit 3: Quadratics

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part A encompasses the first 2 semesters.. In this unit, students will study all aspects of quadratics including equations, graphs, and applications.

Content Standards:

- CCSS.HSA.SSE.A.2: Use the structure of an expression to identify ways to rewrite it.
- CCSS.HSA.SSE.B.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
- CCSS.HSA.SSE.B.3.A: Factor a quadratic expression to reveal the zeros of the function it defines.
- CCSS.HSA.REI.B.4: Solve quadratic equations in one variable.
- CCSS.HSA.REI.B.4.B: Solve quadratic equations by inspection (e.g., for $x2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
- CCSS.HSF.IF.C.7.A: Graph linear and quadratic functions and show intercepts, maxima, and minima. CCSS.HSF.IF.C.8.A: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and

Transfer

Students will be able to independently use their learning to…

- explain the significance of the complex number system
- more thoroughly explain connections graphs and equations of functions through the quadratic function
- apply their knowledge of quadratic functions when solving real world application problems

Meaning

ENDURING UNDERSTANDINGS

- The characteristics of quadratic functions and their representations are useful in solving real-world problems.
- Imaginary numbers exist and can be used to describe solutions.

ESSENTIAL QUESTIONS

- How can we use the quadratic formula to solve real world application problems?
- What is an imaginary number and what is its value?
- How does factoring and finding roots of a polynomial give me solutions to application problems?

Acquisition

Students will understand…

- quadratic equations and inequalities in many forms including graphs, tables, and equations
- characteristics of a quadratic function in both standard and vertex form

Students will be skilled at…

- identifying the vertex, axis of symmetry, direction, maximum or minimum, x and y intercepts, domain and range.
- writing and graphing quadratic equations in vertex and standard form.

symmetry of the graph, and interpret these in terms of a context. ● CCSS.HSN.CN.A.1: Know there is a complex number *i* such that *i*2 = -1, and every complex number has the form *a +* ● *bi* with *a* and *b* real. ● CCSS.HSN.CN.A.2: Use the relation *i*2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. ● CCSS.HSN.CN.A.3: (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. ● CCSS.HSN.CN.B.5: (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. ● CCSS.HSN.CN.C.7: Solve quadratic equations with real coefficients that have complex solutions. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP4 Model with mathematics ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning	● the algebraic methods of factoring, square root property, and the quadratic formula. ● quadratics model everyday situations ● quadratic applications ● complex numbers ● the meaning of complex solutions	● solving quadratics involving real and complex solutions by factoring, square root property, and using the quadratic formula. ● factoring using multiple methods such as GCF, difference of squares, trinomials with leading coefficient ≠1, trinomials with leading coefficient =1. ● identifying characteristics of a quadratic function. ● comparing vertex and standard form of a quadratic function. ● choosing the most efficient and effective method for solving quadratics. ● determining the reasonableness of the answer and find a new solution if needed. ● modeling quadratic problems that arise in everyday life. ● using graphing technology to represent given quadratics. ● performing basic operations of complex numbers.
Used in Content Area Standards		***21st Century Skills***
		● Critical thinking ● Collaboration ● Communication ● Perseverance

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra II Part A
Unit 4: Systems of Equations & Inequalities

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part A encompasses the first 2 semesters.. In this unit, students will solving systems of equations both algebraically and graphically.

Content Standards:
● CCSS.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
● CCSS.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
● CCSS.HSA.REI.C.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
● CCSS.HSA.REI.C.6: Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
● CCSS.HSA.REI.C.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● see the usefulness of systems of equations and inequalities.
● understand the situations that could be represented by a system of equations instead of a single equation.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Systems of equations and inequalities can be used to model and solve problems.</td><td>ESSENTIAL QUESTIONS
● How are systems of linear equations and inequalities useful?
● What situations would be represented by a system of equations or inequalities instead of a single equation or inequality?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● the type of solutions for a system of equations.
● the type of solutions for a system of inequalities.
● the use of linear programming to model and analyze optimization problems</td><td>Students will be skilled at…
● solving a system of linear equations graphically or algebraically using elimination or substitution.
● solving a system of inequalities by graphing.
● writing and graphing constraints using a linear programming model and analyzing the graph to find solutions.
● choosing the most efficient and effective method to solve systems.
● checking the solution for reasonableness of the answer and, if needed, finding a new solution</td></tr>
</table>

algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x2 + y2 = 3$. ● CCSS.HSA.REI.D.11: Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. * ● CCSS.HSA.REI.D.12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP3 Construct viable arguments and critique the reasoning of others CCSS.MP4 Model with mathematics ● CCSS.MP6 Attend to precision		● representing a word description symbolically by a system of equations/inequalities.
Used in Content Area Standards		***21st Century Skills***
		● Critical thinking ● Collaboration ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Algebra 2 Part B (semester class)

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Properties of exponents and Operations of Polynomials	● Properties of exponents ● Polynomials ● Linear, quadratic, cubic ● Synthetic division ● Long division ● Factors, roots, zeros ● a function models a relationship between two quantities by linking factors, zeros, and roots.	● There is an unique relationship between zeros and factors of polynomials	● Multiply and divide polynomials including synthetic and long division ● Perform arithmetic operations on polynomials**.** ● Use the properties of exponents to transform expressions ● Determine the most effective way to divide a polynomial based on if it is linear, coefficient ≠1, quadratic, etc. even though it may have multiple possible approaches. ● Use a graphing calculator to represent given polynomials and analyze the graph.
Unit 2: Radical Expressions and Equations	● Rational exponents and equations with rational exponents ● Radical expressions and equations ● Rational expressions and equations	● Corresponding to every power there is a root. ● Properties of real numbers can be used to simplify radicals. ● A radical expression has an equivalent form using a fractional exponent instead of a radical sign.	● Simplify expressions and solve equations with integer and rational exponents ● Simplify numeric and algebraic radical expression up to the 5th degree ● Solve radical equations ● Solve basic exponential functions ● Simplify rational expressions and solve rational equations ● Convert between rational exponent and radical form
Unit 3: Application of Functions	● Regression equations ● Graph end behavior based on degree ● Critical points on a graph (zeros, local max, local min, etc) ● Interpret graphical points in context of application	● Functions are a mathematical way to describe relationships between two quantities that vary. ● Functions can be represented in a variety of ways and many real world functional relationships can be represented by equations.	● Explore/compare types of functions (linear, quadratic, exponential, etc) to understand their applications ● Graph behavior of various types of functions, with or without technology ● Model applications with appropriate functions (linear, quadratic, exponential, trigonometric, etc) and make predictions based on the model

Windham School District Curriculum
Algebra II Part B (Semester)
Unit 1: Properties of Exponents & Operations of Polynomials

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part B is the final semester for their formal study of Algebra. In this unit, students simplify polynomial expressions as well as explore the graph of the polynomial function using technology.

Content Standards:

- CCSS.HSA.APR.A.1: Understand that polynomials form a system analogous to the integers; namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. CCSS.HSA.APR.B.2: Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
- CCSS.HSA.APR.D.6: Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
- CCSS.HSF.IF.C.7.C: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Transfer

Students will be able to independently use their learning to…

- make connections between graphs and equations of functions through the study of polynomials

Meaning

ENDURING UNDERSTANDINGS

- There is an unique relationship between zeros and factors of polynomials

ESSENTIAL QUESTIONS

- How do factoring and finding roots of a polynomial yield solutions to application problems?

Acquisition

Students will understand…

- properties of exponents.
- Polynomials
- Linear, quadratic, cubic
- synthetic division.
- polynomial long division.
- Students will understand the relationship between factors, roots, and zeros.

Students will be skilled at…

- multiplying and dividing polynomials using both synthetic and long division.
- performing arithmetic operations on polynomials.
- Flexibly using the properties of exponents to transform expressions.
- determining the most effective way to divide a polynomial based on if it is linear, coefficient ≠1, quadratic, etc. even though it may have multiple possible approaches.
- using a graphing calculator or online calculator to represent given polynomials and analyze the graph.

● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision		
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra II Part B (Semester)
Unit 2: Radical & Rational Expressions & Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part B is the final semester for their formal study of Algebra. In this unit, students simplify expressions using radicals. Students will also solve radical and rational equations.

Content Standards:

- CCSS.HSA.APR.D.7: (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
- CCSS.HSA.REI.A.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- CCSS.HSN.RN.A.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5*.
- CCSS.HSN.RN.A.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- CCSS.MP1 Make sense of problems and persevere in solving them

Transfer

Students will be able to independently use their learning to…

- explain the connections and differences between integer exponents and rational exponents
- solve problems using their knowledge of solving radical equations

Meaning

ENDURING UNDERSTANDINGS

- Corresponding to every power there is a root.
- Properties of real numbers can be used to simplify radicals.
- A radical expression has an equivalent form using a fractional exponent instead of a radical sign.

ESSENTIAL QUESTIONS

- How can we make sense of exponents that are not integers?
- Why do rational equations sometimes have extraneous solutions?

Acquisition

Students will understand…

- radical expressions and radical equations.
- rational exponents and their connection to radicals.
- rational expressions
- simplifying radicals are flexible in the order of steps, and understand there are many routes to the same ct answer.

Students will be skilled at…

- simplifying expressions with integer and rational exponents.
- solving equations with integer and rational exponents.
- simplifying numeric and algebraic radical expressions up to the 5th degree.
- solving radical equations.
- solving basic exponential functions.

● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning.		● simplifying rational expressions and solve rational equations. ● converting between rational exponent and radical form.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Algebra II Part B (Semester)
Unit 3: Application of Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with an advanced study of Algebra over 3 semesters. Algebra 2 Part B is the final semester for their formal study of Algebra. In this unit, students simplify expressions using radicals. Students will also solve radical and rational equations.

Content Standards:

- CCSS.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); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- CCSS.HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. CCSS.HSF.IF.C.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*
- CCSS.HSF.BF.A.1: Write a function that describes a relationship between two quantities.*
- CCSS.MP4 Model with mathematics

Transfer

Students will be able to independently use their learning to…

- use patterns found in functions to determine the type of function represented by collected data

Meaning

ENDURING UNDERSTANDINGS

- Functions are a mathematical way to describe relationships between two quantities that vary.
- Functions can be represented in a variety of ways and many real world functional relationships can be represented by equations.

ESSENTIAL QUESTIONS

- How can you represent and describe functions?
- How can functions describe real-world situations, model predictions and solve problems?

Acquisition

Students will understand…

- Regression equations.
- end behavior of graphs based on degree.
- critical points on a graph.
- Interpretation of graphical points in context of its application.

Students will be skilled at…

- comparing types of functions based on degree and exploring their potential applications.
- graphing and describing a function's behavior with or without technology.

● CCSS.MP7 Look for and make use of structure		● finding appropriate functions to model real world scenarios and using their functions to make predictions based on the model.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Collaboration ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Calculus

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Limits	● Limits graphically and numerically ● Limits analytically ● Continuity and one-sided limits ● Infinite limits ● Intermediate Value Theorem. ● Asymptotes of graphs of functions	● Limits are the basis of the study of calculus	● Learn ways limits fail. ● Evaluate a limit using properties of limits. ● Determine continuity at a point and an open interval ● Use the Intermediate Value Theorem ● Determine infinite limits from left and right ● Sketch vertical asymptotes
Unit 2: Differentiation	● Basic differentiation rules, product and quotient rules, the chain rule, and implicit differentiation ● Related rates ● The first and second derivative test ● Optimization problems (max and min values) ● Rollie's Theorem and Mean-Value Theorem.	● Derivatives can be used to analyze curves and model rates of change ● Differentiability implies continuity	● Rolle's Theorem and Mean Value Theorem. ● Evaluate derivatives of various functions using basic differentiation rules ● Use implicit differentiation to find the derivative of functions ● Use related rates to solve real-life problems ● Find the extrema of a function ● Analyze and sketch the graph of a function ● Solve minimum and maximum problems using derivatives ● Differentiability and continuity
Unit 3: Integration	● Antiderivatives and indefinite integration ● Area under a curve ● Riemann sums ● The Fundamental Theorem of Calculus ● Derivatives and integrals of logarithmic and exponential functions	● The Fundamental Theorem of Calculus can be used to solve real-world application ● Integrals can be used to find the area under the curve, the area between two	● Use basic integration rules to find anti-derivatives ● Evaluate a definite integral using the Fundamental Theorem of Calculus ● Find derivatives and integrals of natural logarithms and exponential functions ● Differentiate and integrate inverse trig.

	● Derivatives and integrals of inverse trigonometric functions ● Growth and decay problems ● Area between two curves ● Volume of solids of revolution ● Slope fields ● Indeterminate forms and L'Hopital's Rule ● Mean Value Theorem for integrals ● Riemann sums	curves and the volume of solids of revolution.	Functions ● Find the area between two curves ● Find the volume of a solid of revolution ● Recognize limits that produce indeterminate form. ● Model growth and decay ● Use slope fields ● Find particular solutions to differential equations ● Apply L'Hopital's rule

Windham School District Curriculum
Calculus
Unit 1: Limits

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Calculus. In this unit, students explore limits both graphically and algebraically.

Content Standards:
● There are no common core content standards at this level.
● CCSS.MP1 Make sense of problems and persevere in solving them.
● CCSS.MP2 Reason abstractly and quantitatively.
● CCSS.MP6 Attend to precision.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● use their knowledge of limits in building understanding of derivatives</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Limits are the basis of the study of Calculus.</td><td>ESSENTIAL QUESTIONS
● How is the study of limits integral to the concepts in Calculus?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● limits graphically, numerically, and analytically..
● continuity and their properties
● one-sided limits.
● infinite limits.
● Intermediate Value Theorem.
● Asymptotes of graphs of functions</td><td>Students will be skilled at…
● evaluating a limit using properties of limits.
● Understanding the different ways that a limit can fail to exist.
● determining continuity at a point and continuity on an open interval.
● using properties of continuity.
● using the Intermediate Value Theorem.determining infinite limits from the left and from the right</td></tr>
</table>

		● finding and sketching vertical asymptotes of the graph of a function.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Calculus
Unit 1: Differentiation

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Calculus. In this unit, students learn the many different techniques of differentiation.

Content Standards:
● There are no common core content standards at this level.
● CCSS.MP1 Make sense of problems and persevere in solving them.
● CCSS.MP2 Reason abstractly and quantitatively.
● CCSS.MP 4 Model with mathematics.
● CCSS.MP 5 Use appropriate tools strategically.
● CCSS.MP 6 Attend to precision.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● explain the connections between derivatives and rate of change
● apply derivatives to problems in the sciences as well as real-life problems</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Derivatives can be used to analyze curves and model rates of change
● Differentiability implies continuity</td><td>ESSENTIAL QUESTIONS
● How can we solve real world applications of related rates using derivatives?
● How are derivatives used to analyze and sketch the graphs of functions?
● How do derivatives apply to real world optimization problems?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● basic differentiation rules, product and quotient rules, the chain rule, and implicit differentiation.
● real world related rates problems.
● maximum and minimum values of various functions.
● first and second derivative in terms of analyzing and sketching graphs of functions.</td><td>Students will be skilled at…
● explaining the relationship between differentiability and continuity.
● evaluating derivatives of various functions using basic differentiation rules.
● using related rates to solve real-life problems
● finding extrema of a function.</td></tr>
</table>

	● applied minimum and maximum problems. ● Rollie's Theorem and Mean-Value Theorem.	● using Rollie's Theorem and Mean-Value Theorem. ● analyzing and sketching the graph of a function. ● solving applied minimum and maximum problems using derivatives.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Calculus
Unit 3: Integration

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Calculus. In this unit, students explore the connection between differentiation and integration. The students also learn many different techniques of integration.

Content Standards:

- There are no common core content standards at this level. CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP4 Model with mathematics.
- CCSS.MP5 Use appropriate tools strategically.
- CCSS.MP6 Attend to precision.

Transfer

Students will be able to independently use their learning to…

- explain the connections between derivatives and integrals
- apply integration techniques to problems in the sciences as well as real-life problems

Meaning

ENDURING UNDERSTANDINGS

- The Fundamental Theorem of Calculus can be used to solve real-world applications.
- Integrals can be used to find the area under the curve, the area between two curves and the volume of solids of revolution

ESSENTIAL QUESTIONS

- What is the difference between indefinite and definite integrals?
- Why do we need to use integrals to find the area under a curve?
- How do we find that area?
- How is the Fundamental Theorem of Calculus used to solve real-world applications?
- How is the integral used to find the volume of solids of revolution?

Acquisition

Students will understand…

- anti-derivatives and indefinite integration.
- Significance of the area under a curve.
- Definition of Riemann Sums.

Students will be skilled at…

- using basic integration rules to find anti-derivatives.
- finding a particular solution of a differential equation.

	● the Fundamental Theorem of Calculus. ● derivatives and integrals of logarithmic and exponential functions. ● derivatives and integrals of inverse trigonometric functions. ● growth and decay problems using differential equations. ● area of a region between two curves. ● volume of solids of revolution. ● slope fields. ● indeterminate forms and L'Hopital's Rule.	● evaluating a definite integral using the Fundamental Theorem of Calculus. ● using the Mean Value Theorem for Integrals. ● finding derivatives and integrals of natural logarithms and exponential functions. ● using exponential functions to model compound interest and exponential growth. ● differentiating and integrating inverse trigonometric functions. ● using slope fields to approximate solutions of differential equations. ● finding the area between two curves using integration. ● finding the volume of a solid of revolution. ● recognizing limits that produce the indeterminate form. ● applying L'Hopital's Rule to evaluate a limit.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: AP Calculus AB

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Limits	● Graphical and numerical limits. ● One-sided limits. ● Continuity ● Infinite limits and limits at infinity	● Limits are the basis to the study of Calculus. ● Calculus allows us to generalize knowledge about motion to diverse problems involving change. ● Reasoning with definitions, theorems, and properties can be used to justify claims about limits and continuity. ● Existence theorems allow us to draw conclusions about a function's behavior on an interval without precisely locating that behavior.	● Evaluate a limit using the limit properties. ● Learn different ways a limit fails to exist. ● Determine if a function is continuous at a point or on an open interval. ● Determine infinite limits from the right and left. ● Find limits as x approaches infinity. ● Evaluate limits analytically.
Unit 2: Differentiation	● Limit definition of the derivative and the tangent line problem. ● Graphs of functions and their derivatives. ● Relationship between continuity and differentiability. ● Derivatives using technology. ● Differentiation rules: power, product, quotient, chain rules ● Derivatives of all trigonometric, exponential, logarithmic, and inverse trigonometric functions. ● Derivatives given a table. ● Implicit differentiation. ● Related Rates ● Rolle's, Mean Value, and Intermediate Value Theorems	● Derivatives can be used to solve real world applications. ● Derivatives are used to analyze and sketch the graphs of functions. ● Derivatives allow us to determine rates of change at an instant by applying limits to knowledge about rates of change over intervals. ● Recognizing that a function's derivative may also be a function allows us to develop knowledge about the related behaviors of both. ● Recognizing opportunities to apply derivative rules can simplify differentiation.	● Understand the relationship between continuity and differentiability. ● Graph derivative functions given the graph of the function. ● Use the limit definition of the derivative to find derivatives of polynomial functions. ● Use basic differentiation rules to evaluate derivatives of various functions including polynomial, trigonometric, exponential, and logarithmic functions. ● Differentiate implicitly. ● Solve related rates real-world problems. ● Understand and be able to use Rolle's Theorem, Mean Value Theorem, and Intermediate Value Theorem. ● Find relative and absolute extrema of functions and points of inflection.

	● Extrema ● Analysis and sketch of graphs using 1st and 2nd derivatives ● Applied optimization problems ● L'Hopital's Rule ● Motion – position, velocity, and acceleration		● Analyze a function using the first and second derivatives. ● Solve applied optimization problems using derivatives. ● Look at the graph of the derivative of a function and be able to find characteristics of the function itself. ● Use derivatives to apply L'Hopital's Rule to limits of indeterminate forms. ● Use derivatives to understand the motion of particles.
Unit 3: Integration	● Anti-derivatives and indefinite integrals ● Area under a curve – integral notation and use of geometric area ● Riemann Sums and Trapezoidal Rule ● First and second Fundamental Theorems of Calculus ● Integration using graphing calculator ● Average value of a function ● U-substitution ● Compound interest and exponential growth ● Slope fields ● Differential Equations ● Area between two curves ● Volume of a solid of revolution ● Volumes using cross-sectional areas ● Motion – position, velocity, and acceleration.	● The Fundamental Theorem of Calculus can be used to solve real-world applications ● Integrals can be used to find the area under the curve, the area between two curves, and the volume of solids of revolution.	● Use basic integration techniques to find antiderivatives of various functions including trigonometric, polynomial, exponential, and logarithmic. ● Estimate the area under a curve using Riemann Sums and the Trapezoid Rule. ● Evaluate definite integrals using the Fundamental Theorem of Calculus ● Use the graphing calculator to evaluate integrals. ● Use integrals to find the average value of a function. ● Use integrals of exponential functions to model compound interest and exponential growth. ● Use slope fields to approximate solutions of differential equations. ● Find a particular solution to a differential equation. ● Find the area between two curves using integration. ● Find volumes of solids of revolution. ● Find volumes using cross-sectional areas. ● Use integrals to further one's understanding of the motion particles.

Windham School District Curriculum
AP Calculus AB
Unit 1: Limits

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of AP Calculus AB. In this unit, students explore limits both graphically and algebraically. 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.

Competencies (Standards):

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations.
- *2.C* Identify a re-expression of mathematical information presented in a given representation.
- *3.C* Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied

Transfer

Students will be able to independently use their learning to…

- recognize that limits are the foundation for differentiation and integration.
- understand that limits are the basis for important definitions and for theorems that are used to solve realistic problems involving change and to justify conclusions.

Meaning

ENDURING UNDERSTANDINGS

- Limits are the basis to the study of Calculus.
- Calculus allows us to generalize knowledge about motion to diverse problems involving change.
- Reasoning with definitions, theorems, and properties can be used to justify claims about limits and continuity.
- Existence theorems allow us to draw conclusions about a function's behavior on an interval without precisely locating that behavior.

ESSENTIAL QUESTIONS

- How is the study of limits integral to the concepts in Calculus?
- Can change occur at an instant?
- How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?

Acquisition

Students will understand…

- the concept of limits graphically and numerically.
- the concept of continuity and one-sided limits.
- infinite limits and limits at infinity.

Students will be skilled at…

- evaluating a limit using properties of limits.
- understanding the different ways that a limit can fail to exist.
- determining continuity at a point and continuity on an open interval.
- using properties of continuity.

Content Standards: ● There are no common core content standards at this level. ● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation		● determining infinite limits from the left and from the right. ● finding limits as x approaches infinity. ● evaluating limits analytically.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Collaboration ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Calculus AB
Unit 2: Differentiation

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their advanced study of mathematics with a study of AP Calculus AB. In this unit, students learn the many different techniques of differentiation. Derivatives allow us to determine instantaneous rates of change. To develop understandings of how the definition of the derivative applies limits to average rates of change, create opportunities for students to explore average rates of change over increasingly small intervals.

Competencies (Standards?):

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.D* Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems.

Transfer

Students will be able to independently use their learning to…

- develop differentiation skills that will allow them to model realistic instantaneous rates of change and to analyze graphs.

Meaning

ENDURING UNDERSTANDINGS

- Derivatives can be used to solve real world applications.
- Derivatives are used to analyze and sketch the graphs of functions.
- Derivatives allow us to determine rates of change at an instant by applying limits to knowledge about rates of change over intervals.
- Recognizing that a function's derivative may also be a function allows us to develop knowledge about the related behaviors of both.
- Recognizing opportunities to apply derivative rules can simplify differentiation.

ESSENTIAL QUESTIONS

- How can we solve real world related rates applications using derivatives?
- How are derivatives used to analyze and sketch the graphs of functions?
- How do derivatives apply to real world optimization problems?
- Since certain indeterminate forms seem to actually approach a limit, how can we determine that limit, provided it exists?

Acquisition

Students will understand…

- Limit definition of the derivative and the tangent line problem.
- basic differentiation rules, product and quotient rules, the chain rule, and implicit differentiation.

Students will be skilled at…

- understanding the relationship between differentiability and continuity.
- evaluating derivatives of various functions including polynomial, trigonometric, exponential, and logarithmic using basic differentiation rules.

● *1.E* Apply appropriate mathematical rules or procedures, with and without technology. ● *2.A* Identify common underlying structures in problems involving different contextual situations. ● *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations. ● *2.D* Identify how mathematical characteristics or properties of functions are related in different representations. ● *3.D* Apply an appropriate mathematical definition, theorem, or test. ● *3.E* Provide reasons or rationales for solutions and conclusions. ● *3.F* Explain the meaning of mathematical solutions in context. ● *3.G* Confirm that solutions are accurate and appropriate. ● *4.C* Use appropriate mathematical symbols and notation (e.g., Represent a derivative using *f'(x), y', and dy/dx*). *Content Standards:* ● There are no common core content standards at this level. ● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation	● real world related rates problems. ● L'Hopital's Rule to evaluate limits ● maximum and minimum values of various functions. ● optimization problems. ● the characteristics of motion using derivatives. ● Rolle's Theorem, Mean Value Theorem, and the Intermediate Value Theorem. ● connections between the graphs of functions and their derivatives. ● the relationship between differentiability and continuity. ● derivatives of all trigonometric, exponential, logarithmic, and inverse trigonometric functions ● implicit differentiation ● the analysis and sketches of graphs using 1st and 2nd derivatives	● given the graph of the derivative, finding characteristics of the function itself ● distinguishing between functions written in implicit form and explicit form and using implicit differentiation to find the derivative of functions. ● using related rates to solve real-life problems. ● finding relative and absolute extrema and points of inflection of a function. ● using Rolle's Theorem, Mean-Value Theorem and Intermediate Value Theorem. ● determining intervals on which a function is increasing or decreasing, is concave up or down, and finding points of inflection in order to analyze and sketch the graph of a function using both 1st and 2nd derivatives ● solving applied optimization problems using derivatives. ● recognizing limits that produce indeterminate forms and applying L'Hopital's Rule to evaluate limits. ● using derivatives to understand the motion of particles. ● graphing derivative functions given the graph of the function. ● using the limit definition of the derivative to find derivatives of polynomial functions. ● finding derivatives using technology

Used in Content Area Standards	*21st Century Skills*
	● Critical Thinking ● Collaboration ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Calculus AB
Unit 3: Integration

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of AP Calculus AB. In this unit, students explore the connection between differentiation and integration. This unit establishes the relationship between differentiation and integration using the Fundamental Theorem of Calculus.

Competencies (Standards):

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.D* Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems.
- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations.
- *2.C* Identify a re-expression of mathematical information presented in a given representation.

Transfer

Students will be able to independently use their learning to…

- understand that integration is a limiting case of a sum of products (areas) in the same way that differentiation is a limiting case of a quotient of differences (slopes).

Meaning

ENDURING UNDERSTANDINGS

- The Fundamental Theorem of Calculus can be used to solve real-world applications.
- Integrals can be used to find the area under the curve, the area between two curves, and the volume of solids of revolution.

ESSENTIAL QUESTIONS

- What is the difference between indefinite and definite integrals?
- Why do we need to use integrals to find the area under a curve?
- How is the Fundamental Theorem of Calculus used to solve real-world applications?
- How is the integral used to find the volume of solids of revolution?

Acquisition

Students will understand…

- the concepts of the antiderivatives and indefinite integration.
- the area under a curve.
- Riemann Sums and Trapezoidal Rule.
- the first and second Fundamental Theorems of Calculus.
- integration of the natural logarithmic function, exponential functions, inverse trigonometric functions and u-substitution
- concept of slope fields.

Students will be skilled at…

- using basic integration rules to find antiderivatives of various functions including trigonometric, polynomial, exponential, and logarithmic.
- finding particular solutions for differential equations.
- estimating the area under curves using Riemann sums and Trapezoidal Rule.
- evaluating a definite integral using the Fundamental Theorem of Calculus.

● *2.D* Identify how mathematical characteristics or properties of functions are related in different representations. ● *3.D* Apply an appropriate mathematical definition, theorem, or test. ● *3.F* Explain the meaning of mathematical solutions in context. ● *3.G* Confirm that solutions are accurate and appropriate. ● *4.C* Use appropriate mathematical symbols and notation (e.g., Represent a derivative using *f'(x), y', and dy/dx*). ● *4.D* Use appropriate graphing techniques. ● *4.E* Apply appropriate rounding procedures ● *Content Standards:* ● There are no common core content standards at this level. ● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation	● the area of a region between two curves. ● solids of revolution ● how integrals fit within the analysis of the motion of a particle. ● average value of a function	● using exponential functions to model compound interest and exponential growth. ● using slope fields to approximate solutions of differential equations. ● using separation of variables to solve a simple differential equation and to find particular solutions ● finding the area between two curves using integration. ● finding the volume of a solid of revolution. ● using the graphing calculator to evaluate definite integrals. ● using integrals to further their analysis of the motion of particles. ● using integrals to find the average value of a function. ● finding volumes using cross-sectional areas. ● solving growth and decay problems using differential equations.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Collaboration ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: AP Calculus BC

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Limits	● Graphical and numerical limits. ● One-sided limits. ● Continuity ● Infinite limits and limits at infinity	● Limits are the basis to the study of Calculus ● Calculus allows us to generalize knowledge about motion to diverse problems involving change. ● Reasoning with definitions, theorems, and properties can be used to justify claims about limits and continuity. ● Existence theorems allow us to draw conclusions about a function's behavior on an interval without precisely locating that behavior.	● Evaluate a limit using the limit properties. ● Learn different ways a limit fails to exist. ● Determine if a function is continuous at a point or on an open interval. ● Determine infinite limits from the right and left. ● Find limits as x approaches infinity.
Unit 2: Differentiation	● Limit definition of the derivative and the tangent line problem. ● Graphs of functions and their derivatives. ● Relationship between continuity and differentiability. ● Derivatives using technology. ● Differentiation rules: power, product, quotient, chain rules ● Derivatives of all trigonometric, exponential, logarithmic, and inverse trigonometric functions. ● Derivatives given a table. ● Implicit differentiation. ● Related Rates ● Rolle's, Mean Value, and Intermediate Value Theorems ● Extrema	● Derivatives can be used to solve real world applications. ● Derivatives are used to analyze and sketch the graphs of functions. ● Derivatives allow us to determine rates of change at an instant by applying limits to knowledge about rates of change over intervals. ● Recognizing that a function's derivative may also be a function allows us to develop knowledge about the related behaviors of both. ● Recognizing opportunities to apply derivative rules can simplify differentiation.	● Understand the relationship between continuity and differentiability. ● Graph derivative functions given the graph of the function. ● Use the limit definition of the derivative to find derivatives of polynomial functions. ● Use basic differentiation rules to evaluate derivatives of various functions including polynomial, trigonometric, exponential, and logarithmic functions. ● Differentiate implicitly. ● Solve related rates real-world problems. ● Understand and be able to use Rolle's Theorem, Mean Value Theorem, and Intermediate Value Theorem.

	● Analysis and sketch graphs using 1st and 2nd derivatives ● Applied optimization problems ● L'Hopital's Rule ● Motion – position, velocity, and acceleration		● Find relative and absolute extrema of functions and points of inflection. ● Analyze a function using the first and second derivatives. ● Solve applied optimization problems using derivatives. ● Look at the graph of the derivative of a function and be able to find characteristics of the function itself. ● Use derivatives to apply L'Hopital's Rule to limits of indeterminate forms. ● Use derivatives to understand the motion of particles.
Unit 3: Integration	● Anti-derivatives. ● Area under a curve – integral notation and use of geometric area ● Riemann Sums and Trapezoidal Rule ● First and second Fundamental Theorems of Calculus ● Integration using graphing calculator ● Average value of a function ● U-substitution ● Integration by Parts ● Linear Partial Fractions ● Improper Integrals ● Compound interest and exponential growth ● Slope fields ● Differential Equations ● Approximating Solutions using Euler's Method	● The Fundamental Theorem of Calculus can be used to solve real-world applications ● Integrals can be used to find the area under the curve, the area between two curves, and the volume of solids of revolution.	● Use basic and advanced integration techniques to find antiderivatives of various functions including trigonometric, polynomial, exponential, logarithmic and rational functions. ● Estimate the area under a curve using Riemann Sums and the Trapezoid Rule. ● Evaluate definite integrals using the Fundamental Theorem of Calculus ● Use the graphing calculator to evaluate integrals. ● Use integrals to find the average value of a function. ● Use integrals of exponential functions to model compound interest and exponential growth. ● Use slope fields to approximate solutions of differential equations. ● Find a particular solution to a differential equation. ● Use Euler's Method to approximate the

	• Logistic Models with Differential Equations • Area between two curves • Volume of a solid of revolution • Volumes using cross-sectional areas • Arc Length of a smooth, planar curve and distance traveled • Motion – position, velocity, and acceleration.		solution to a differential equation. • Determine the length of a curve in the plane defined by a function, using a definite integral • Find the area between two curves using integration. • Find volumes of solids of revolution. • Find volumes using cross-sectional areas. • Use integrals to investigate the motion particles.
Unit 4: Infinite Sequences and Series	• Define Convergent and Divergent Infinite Series • Geometric Series • The nth Term Test for Divergence • Integral Test for Convergence • Harmonic Series and *p*-Series • Comparison Tests for Convergence • Alternating Series Test for Convergence • Ratio Test for Convergence • Determine Absolute or Conditional Convergence • Alternating Series Error Bound • Taylor Polynomial Approximations of Functions • Lagrange Error Bound • Radius and Interval of Convergence of Power Series • Taylor or Maclaurin Series for a Function • Represent Functions as Power Series	• Applying limits may allow us to determine the finite sum of infinitely many terms. • Power series allow us to represent associated functions on an appropriate interval.	• Determine whether a series converges or diverges. • Find the *n*th partial sum of a given series. • Determine when a common series of numbers, including geometric, harmonic, alternating harmonic, and *p*-series, converges or diverges. • Apply the *n*th term test for divergence of a series. • Establish the criteria necessary to use the integral test for convergence and, if appropriate, determine whether a series converges or diverges. • Use the comparison test or the limit comparison test, when appropriate, to determine whether a series converges or diverges. • Use the alternating series test to determine whether an alternating series converges or diverges.

			● Use the ratio test, when appropriate, to determine whether a series of numbers converges or diverges. ● Determine whether a series is absolutely convergent, conditionally convergent, or divergent. ● Given an alternating series converges by the alternating series test, then use the alternating series error bound to determine the bounds for how far a partial sum is from the value of the infinite series. ● Represent a function at a point as a Taylor Polynomial. ● Use Taylor Polynomials to approximate the value of a function at a given x-value. ● Use the Lagrange Error Bound to determine the error bound associated with a Taylor polynomial approximation. ● Determine the radius of convergence and interval of convergence for a power series. ● Represent a function as a Taylor series or a Maclaurin series. ● Interpret Taylor series and Maclaurin series. ● Represent a given function as a power series. ●
Parametric Equations, Polar Coordinates, and Vector-Valued Functions	● Define and Differentiate Parametric Equations	● Derivatives allow us to solve real-world problems involving rates of change.	● Calculate first and second derivatives of parametric functions.

	● Second Derivative of Parametric Equations ● Arc Length of Curves Given by Parametric Equations ● Define and Differentiate Vector-Valued Functions. ● Integrate Vector-Valued Functions. ● Motion Problems using Parametric and Vector-Valued Functions. ● Define Polar Coordinates and Differentiating in Polar Form ● Area of a Polar Region Bounded by a Single Polar Curve ● Area of the Region Bounded by Two Polar Curves	● Definite integrals allow us to solve problems involving the accumulation of change in length over an interval. ● Solving an initial value problem allows us to determine an expression for the position of a particle moving in the plane. ● Recognizing opportunities to apply derivative rules can simplify differentiation. ● Definite integrals allow us to solve problems involving the accumulation of change in area or volume over an interval.	● Determine the length of a curve in the plane defined by parametric functions, using a definite integral. ● Calculate the derivatives of vector-valued functions. ● Determine a particular solution given a rate vector and initial conditions. ● Determine values for positions and rates of change in problems involving planar motion. ● Calculate derivatives of functions written in polar coordinates. ● Calculate areas of regions defined by polar curves and between two polar curves using definite integrals.

Windham School District Curriculum
AP Calculus BC
Unit 1: Limits

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of AP Calculus BC. In this unit, students explore limits both graphically and algebraically. 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.

Competencies (Standards):

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations.
- *2.C* Identify a re-expression of mathematical information presented in a given representation.
- *3.C* Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied.

Content Standards:

- There are no common core content standards at this level.

Transfer

Students will be able to independently use their learning to…

- recognize that limits are the foundation for differentiation and integration.
- understand that limits are the basis for important definitions and for theorems that are used to solve realistic problems involving change and to justify conclusions.

Meaning

ENDURING UNDERSTANDINGS

- Limits are the basis to the study of Calculus.
- Calculus allows us to generalize knowledge about motion to diverse problems involving change.
- Reasoning with definitions, theorems, and properties can be used to justify claims about limits and continuity.
- Existence theorems allow us to draw conclusions about a function's behavior on an interval without precisely locating that behavior.

ESSENTIAL QUESTIONS

- How is the study of limits integral to the concepts in Calculus?
- Can change occur at an instant?
- How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?

Acquisition

Students will understand…

- limits graphically and numerically.
- the concept of continuity and one-sided limits.
- infinite limits and limits at infinity.

Students will be skilled at…

- evaluating a limit using properties of limits.
- understanding the different ways that a limit can fail to exist.

● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation		● determining continuity at a point and continuity on an open interval. Students will be able to use properties of continuity. ● determining infinite limits from the left and from the right. ● finding limits as x approaches infinity. ● evaluating limits analytically.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Calculus BC
Unit 2: Differentiation

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of AP Calculus BC. In this unit, students learn the many different techniques of differentiation. Derivatives allow us to determine instantaneous rates of change. To develop understandings of how the definition of the derivative applies limits to average rates of change, create opportunities for students to explore average rates of change over increasingly small intervals.

Competencies (Standards):

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.D* Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems.
- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *2.A* Identify common underlying structures in problems involving different contextual situations.
- *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations.

Transfer

Students will be able to independently use their learning to…

- develop differentiation skills that will allow them to model realistic instantaneous rates of change and to analyze graphs.

Meaning

ENDURING UNDERSTANDINGS

- Derivatives can be used to solve real world applications.
- Derivatives are used to analyze and sketch the graphs of functions.
- Derivatives allow us to determine rates of change at an instant by applying limits to knowledge about rates of change over intervals.
- Recognizing that a function's derivative may also be a function allows us to develop knowledge about the related behaviors of both.
- Recognizing opportunities to apply derivative rules can simplify differentiation.

ESSENTIAL QUESTIONS

- How can we solve real world related rates applications using derivatives?
- How are derivatives used to analyze and sketch the graphs of functions?
- How do derivatives apply to real world optimization problems?
- Since certain indeterminate forms seem to actually approach a limit, how can we determine that limit, provided it exists?

Acquisition

Students will understand…

- basic differentiation rules, product and quotient rules, the chain rule, and implicit differentiation.

Students will be skilled at…

- understanding the relationship between differentiability and continuity.

● *2.D* Identify how mathematical characteristics or properties of functions are related in different representations. ● *3.D* Apply an appropriate mathematical definition, theorem, or test. ● *3.E* Provide reasons or rationales for solutions and conclusions. ● *3.F* Explain the meaning of mathematical solutions in context. ● *3.G* Confirm that solutions are accurate and appropriate. ● *4.C* Use appropriate mathematical symbols and notation (e.g., Represent a derivative using *f'(x), y', and dy/dx*). *Content Standards:* ● There are no common core content standards at this level. ● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation	● real world related rates problems. ● maximum and minimum values of various functions. ● applied minimum and maximum problems ● the characteristics of motion using derivatives. ● Rolle's Theorem, Mean Value Theorem, and the Intermediate Value Theorem. ● the connections between the graphs of functions and their derivatives. ● the relationship between differentiability and continuity.	● evaluating derivatives of various functions including polynomial, trigonometric, exponential, and logarithmic using basic differentiation rules. ● distinguishing between functions written in implicit form and explicit form and using implicit differentiation to find the derivative of functions. ● using related rates to solve real-life problems. ● finding extremes of a function. ● using Rolle's Theorem, Mean-Value Theorem and Intermediate Value Theorem. ● determining intervals on which a function is increasing or decreasing, is concave up or down, and finding points of inflection in order to analyze and sketch the graph of a function. ● solving applied minimum and maximum problems using derivatives. ● recognizing limits that produce indeterminate forms and applying L'Hopital's Rule to evaluate limits. ● using derivatives to understand the motion of particles. ● graphing derivative functions given the graph of the function. ● using the limit definition of the derivative to find derivatives of polynomial functions.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Calculus BC
Unit 3: Integration

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of AP Calculus BC. In this unit, students explore the connection between differentiation and integration. This unit establishes the relationship between differentiation and integration using the Fundamental Theorem of Calculus.

Content Standards

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.D* Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems.
- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations.
- *2.C* Identify a re-expression of mathematical information presented in a given representation.
- *2.D* Identify how mathematical characteristics or properties of functions are related in different representations.
- *3.D* Apply an appropriate mathematical definition, theorem, or test.

Transfer

Students will be able to independently use their learning to…

- understand that integration is a limiting case of a sum of products (areas) in the same way that differentiation is a limiting case of a quotient of differences (slopes).

Meaning

ENDURING UNDERSTANDINGS

- The Fundamental Theorem of Calculus can be used to solve real-world applications
- Integrals can be used to find the area under the curve, the area between two curves, and the volume of solids of revolution.

ESSENTIAL QUESTIONS

- What is the difference between indefinite and definite integrals?
- Why do we need to use integrals to find the area under a curve?
- How is the Fundamental Theorem of Calculus used to solve real-world applications?
- How is the integral used to find the volume of solids of revolution?

Acquisition

Students will understand…

- the concepts of the antiderivatives and indefinite integration.
- the area under a curve.
- the concept of Riemann Sums and Trapezoidal Rule.
- the first and second Fundamental Theorems of Calculus.

Students will be skilled at…

- using basic integration rules to find antiderivatives of various functions including trigonometric, polynomial, exponential, and logarithmic.
- finding particular solutions for differential equations.
- evaluating the area under curves using Riemann sums and Trapezoidal Rule.

● *3.F* Explain the meaning of mathematical solutions in context. ● *3.G* Confirm that solutions are accurate and appropriate. ● *4.C* Use appropriate mathematical symbols and notation (e.g., Represent a derivative using *f'(x), y', and dy/dx*). ● *4.D* Use appropriate graphing techniques. ● *4.E* Apply appropriate rounding procedures *Content Standards:* ● There are no common core content standards at this level. ● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation	● integration of the natural logarithmic function, exponential functions, and inverse trigonometric functions. ● the concept of slope fields. ● solids of revolution ● how integrals fit in with the analysis of the motion of a particle.	● evaluating a definite integral using the Fundamental Theorem of Calculus. ● using exponential functions to model compound interest and exponential growth. ● using slope fields to approximate solutions of differential equations. ● using separation of variables to solve a simple differential equation. ● finding the area between two curves using integration. ● finding the volume of a solid of revolution. ● using the graphing calculator to evaluate definite integrals. ● using integrals to further their analysis of the motion of particles. ● using integrals to find the average value of a function. ● finding volumes using cross-sectional areas. solving growth and decay problems using differential equations.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Calculus BC
Unit 4: Infinite Sequences & Series

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of AP Calculus BC. In this unit, students need to understand that a sum of infinitely many terms may converse to a finite value.

Competencies (Standards):

- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *1.F* Explain how an approximated value relates to the actual value..
- *2.C* Identify a re-expression of mathematical information presented in a given representation.
- *3.B* Identify an appropriate mathematical definition, theorem, or test to apply.
- *3.D* Apply an appropriate mathematical definition, theorem, or test.

Content Standards:

- There are no common core content standards at this level.
- The standards below are AP Calculus Mathematical Practices Standards

Transfer

Students will be able to independently use their learning to…

- explore graphs, tables, and symbolic expressions for series that converge and diverge and for Taylor polynomials.

Meaning

ENDURING UNDERSTANDINGS

- Applying limits may allow us to determine the finite sum of infinitely many terms.
- Power series allow us to represent associated functions on an appropriate interval.

ESSENTIAL QUESTIONS

- How can the sum of infinitely many discrete terms be a finite value or represent a continuous function?

Acquisition

Students will understand…

- convergent and divergent infinite series
- geometric series
- when to use the nth term test for divergence
- when to use the Integral Test for Convergence
- harmonic series and *p*-series
- when to use comparison tests for convergence
- when to use the alternating series test for convergence
- the ratio test for convergence
- absolute or conditional convergence
- alternating series error bound

Students will be skilled at…

- determining whether a series converges or diverges.
- finding the *n*th partial sum of a given series.
- determining when a common series of numbers, including geometric, harmonic, alternating harmonic, and *p*-series, converges or diverges.
- applying the *n*th term test for divergence of a series.
- establishing the criteria necessary to use the integral test for convergence and, if appropriate, determine whether a series converges or diverges.
- using the comparison test or the limit comparison test, when appropriate, to determine whether a series converges or diverges.

● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation	● Taylor polynomial approximations of functions ● Lagrange error bound ● radius and interval of convergence of power series ● Taylor or Maclaurin series for a function ● functions as representations of power series	● using the alternating series test to determine whether an alternating series converges or diverges. ● using the ratio test, when appropriate, to determine whether a series of numbers converges or diverges. ● determining whether a series is absolutely convergent, conditionally convergent, or divergent. ● Given an alternating series converges by the alternating series test, using the alternating series error bound to determine the bounds for how far a partial sum is from the value of the infinite series. ● representing a function at a point as a Taylor Polynomial. ● using Taylor Polynomials to approximate the value of a function at a given x-value. ● using the Lagrange Error Bound to determine the error bound associated with a Taylor polynomial approximation. ● determining the radius of convergence and interval of convergence for a power series. ● representing a function as a Taylor series or a Maclaurin series. ● interpreting Taylor series and Maclaurin series. ● representing a given function as a power series.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Calculus BC
Unit 5: Parametric Equations, Polar Coordinates, and Vector-Valued Functions

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their advanced study of mathematics with a study of AP Calculus BC.

In this unit, students will build on their understanding of straight-line motion to solve problems in which particles are moving along curves in a plane. Parametric equations and vector-valued functions will be used to describe planar motion. Students will learn that polar equations are a special case of parametric equations and will apply calculus to analyze graphs and determine lengths and areas.

Competencies (Standards):

- *1.C* Identify an appropriate mathematical rule or procedure based on the classification (e.g., Use the chain rule to find the derivative of a composite function)
- *1.D* Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems.
- *1.E* Apply appropriate mathematical rules or procedures, with and without technology.
- *2.B* Identify mathematical information from graphical, symbolic, numerical, and/or verbal representations.

Transfer

Students will be able to independently use their learning to…

- apply calculus to solve motion problems involving parametric and vector-valued functions.
- apply calculus to analyze graphs in polar form and to determine lengths and areas.

Meaning

ENDURING UNDERSTANDINGS

- Derivatives allow us to solve real-world problems involving rates of change.
- Definite integrals allow us to solve problems involving the accumulation of change in length over an interval.
- Solving an initial value problem allows us to determine an expression for the position of a particle moving in the plane.
- Recognizing opportunities to apply derivative rules can simplify differentiation.
- Definite integrals allow us to solve problems involving the accumulation of change in area or volume over an interval.

ESSENTIAL QUESTIONS

- How can we model motion not constrained to a linear path?
- How does the chain rule help us to analyze graphs defined using parametric equations or polar functions?

Acquisition

Students will understand…

- parametric equations and their derivatives
- the arc length of curves given by parametric equations

Students will be skilled at…

- calculating first and second derivatives of parametric functions.

● *2.C* Identify a re-expression of mathematical information presented in a given representation. ● *2.D* Identify how mathematical characteristics or properties of functions are related in different representations. ● *3.D* Apply an appropriate mathematical definition, theorem, or test. ● *3.F* Explain the meaning of mathematical solutions in context. ● *3.G* Confirm that solutions are accurate and appropriate. ● *4.C* Use appropriate mathematical symbols and notation (e.g., Represent a derivative using *f'(x), y', and dy/dx*). ● *4.D* Use appropriate graphing techniques. ● *4.E* Apply appropriate rounding procedures *Content Standards:* ● There are no common core content standards at this level. ● The standards below are AP Calculus Mathematical Practices Standards ● Practice 1 - Implementing Mathematical Processes ● Practice 2 - Connecting Representations ● Practice 3 - Justification ● Practice 4 - Communication and Notation	● vector-valued functions ● polar coordinates ● the area of a polar region bounded by a single polar curve as well as the area of the region bounded by two polar curves	● determining the length of a curve in the plane defined by parametric functions, using a definite integral. ● calculating the derivatives of vector-valued functions. ● determining a particular solution given a rate vector and initial conditions. ● determining values for positions and rates of change in problems involving planar motion. ● calculating derivatives of functions written in polar coordinates. ● calculating areas of regions defined by polar curves and between two polar curves using definite integrals. ● solving motion problems involving parametric and vector-valued functions
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Fundamentals of Mathematics (I and II)

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Decimals	● Decimals ● Place Value of whole numbers and decimals ● What it means to round a number	● Decimals have place values related by groups (powers) of 10. ● Strategies for adding, subtracting, multiplying, and dividing decimals are the same strategies we have always used with whole numbers.	● Read and write whole numbers and decimals ● Round whole and decimal numbers ● Add, subtract, multiply, and divide whole numbers and decimals
Unit 2: Fractions	● Equivalent fractions ● Proper and improper fractions ● Simplest form of a fraction	● Fractions with unlike denominators can be added or subtracted by replacing fractions with equivalent fractions with like denominators. ● The inverse relationship between multiplication and division can be used to divide with fractions.	● Simplify fractions ● Add, subtract, multiply, and divide fractions
Unit 3: Integers and Algebraic Expressions	● integers ● exponents ● Numerical and algebraic expression ● order of operations ● like terms in an expression ● distributive property	● Integers are useful for noting relative changes or values. ● Every numerical operation has an inverse. ● Previous understandings of arithmetic operations can be extended to algebraic expressions.	● Add, subtract, multiply, and divide integers ● Evaluate numerical expressions containing exponents ● Write algebraic expressions ● Simplify numerical expressions using the order of operations ● Evaluate algebraic expressions ● Simplify algebraic expressions including the use of the distributive property and combine like terms
Unit 4: Equations	● solutions of equations ● Inverse operations ● like terms ● distributive property	● An equation represents two quantities that are equal and can be used as a tool to find an unknown value. ● Solving equations is a process of working backwards using opposite operations.	● Solve one step and two step equations ● Solve equations by combining like terms ● Solve equations using the distributive property ● Solve equations with variables on both sides

Unit 5: Exponents	● product, quotient, and power rules of exponents ● negative exponents and zero exponents	● Exponential notation is an efficient way of expressing numbers.	● Simplify expressions using the product, quotient, and power rules of exponents
Unit 6: Ratios, Proportions, and Percents	● Ratios and proportions ● equivalency of fractions, decimals, and percents ● mark-up, tax, and discount	● Proportional relationships express how quantities change in relationship to each other. ● Proportions are a tool for calculating percentages and finding missing pieces of information. ● Real life data is often represented as percentages.	● Determine if two ratios create a proportion ● Solve proportions. ● Use proportions to solve problems. ● Solve percent equations. ● Solve word problems using percents. This includes, but is not limited to, mark-up, tax, discount, and percent of change.
Unit 7: Graphing & Writing Linear Equations	● ordered pair, coordinate plane, origin, x-axis and y-axis, quadrants ● slope of a line (rate of change) ● slope-intercept and standard forms of a linear equation ● Relationships between a linear equation, the graph of the linear equation, and the solution to the linear equation	● Slope is a constant rate of change. ● Equations describe the association between two quantities. ● Every line on a coordinate plane consists of an infinite number of points represented by an equation.	● Plot points on the coordinate plane ● Find a solution to a linear equation by creating a table of values. ● Find the slope of a line given a graph, 2 points, and a linear equation ● Graph linear equations given an equation in slope-intercept form and standard form ● Write a linear equation from the graph of a line

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 1: Decimals

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will review decimal operations as well as place value of whole numbers and decimals.

Content Standards:
● CCSS.6.NS.B.3 Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
● CCSS.MP1 Make sense of problems and persevere in solving them
● CCSS.MP6 Attend to precision.
● CCSS.MP7 Look for and make use of structure</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● fluently perform operations of decimals
● explain the similarities and differences between whole numbers and decimals with an emphasis on place value</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Decimals have place values related by groups (powers) of 10.
● Strategies for adding, subtracting, multiplying, or dividing decimals are the same strategies we have always used with whole numbers.</td><td>ESSENTIAL QUESTIONS
● How does knowledge of place value help in rounding whole numbers and decimals?
● How are operations of whole numbers and decimals connected?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● decimals.
● place value of whole numbers and decimals.
● what it means to round a number.</td><td>Students will be skilled at…
● reading and writing whole numbers and decimals.
● rounding whole and decimal numbers.
● adding, subtracting, multiplying, and dividing whole numbers and decimals.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Critical thinking
● Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 2: Fractions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="8">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will review fractional operations.

Content Standards:
● CCSS.MATH.CONTENT.6.NS.A.1 Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.
● CCSS.MP1 Make sense of problems and persevere in solving them
● CCSS.MP5 Use appropriate tools strategically
● CCSS.MP6 Attend to precision.
● CCSS.MP7 Look for and make use of structure</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● fluently perform operations with fractions and apply these skills when solving real-life problems
● connect fraction operations in future studies of algebraic fractions</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Fractions with unlike denominators can be added or subtracted by replacing fractions with equivalent fractions with like denominators.
● The inverse relationship between multiplication and division can be used to divide with fractions.</td><td>ESSENTIAL QUESTIONS
● Why can’t we add and subtract fractions with unlike denominators without finding a common denominator?
● What real world situations and problems involve computing with fractions?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● when fractions are equivalent.
● proper and improper fractions.
● when a fraction is in simplest form</td><td>Students will be skilled at…
● simplifying fractions.
● adding, subtracting, multiplying, and dividing fractions.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Communication
● Critical Thinking</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 3: Integers & Algebraic Expressions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will add, subtract, multiply, and divide integers. They will also simplify algebraic expressions.

Content Standards:

- CCSS.6.NS.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values 9e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
- CCSS.7.NS.1. a. Describe situations in which quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.*
- CCSS.7.NS.2.b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number.

Transfer

Students will be able to independently use their learning to…

- apply their knowledge of signed numbers when solving real-life problems
- use their knowledge of simplifying expressions when solving multi-step equations

Meaning

ENDURING UNDERSTANDINGS

- Integers are useful for noting relative changes or values.
- Every numerical operation has an inverse.
- Previous understandings of arithmetic operations can be extended to algebraic expressions.

ESSENTIAL QUESTIONS

- What do integers represent?
- What is x?
- What is the connection between arithmetic and expressions?

Acquisition

Students will understand…

- integers.
- exponents.
- numerical and algebraic expressions.
- order of operations.
- like terms in an expression.
- distributive property.

Students will be skilled at…

- adding, subtracting, multiplying, and dividing integers.
- evaluating numerical expressions containing exponents.
- writing algebraic expressions.
- simplifying numerical expressions using the order of operations.
- evaluating algebraic expressions.
- simplifying algebraic expressions including the use of the distributive property and combining like terms

● CCSS.6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents. ● CCSS.6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers. ● CCSS.6.EE.A.3 Apply the properties of operations to generate equivalent expressions. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision ● CCSS.MP7 Look for and make use of structure		
Used in Content Area Standards		***21st Century Skills***
		● Communication ● Critical Thinking

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 4: Equations

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="8">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will solve multi-step equations.

Content Standards:
● CCSS.MATH.CONTENT.8.EE.C.7 Solve linear equations in one variable.
● CCSS.MP1 Make sense of problems and persevere in solving them
● CCSS.MP2 Reason abstractly and quantitatively.
● CCSS.MP7 Look for and make use of structure</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● apply their skill of solving equations as a tool for problem solving</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● An equation represents two quantities that are equal and can be used as a tool to find an unknown value.
● Solving equations is a process of working backwards using opposite operations.</td><td>ESSENTIAL QUESTIONS
● How are equations used as a problem-solving tool?
● How could we tell if a number was a solution to an equation?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will undertand…
● the solution of an equation.
● inverse operations.
● like terms.
● distributive property.</td><td>Students will be skilled at…
● Solving one-step and two-step equations..
● solving equations by first combining like terms.
● solving equations using the distributive property.
● Solving equations with variables on both sides.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Communication
● Critical Thinking</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 5: Exponents

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will explore the properties of exponents.

Content Standards:
● CCSS.MATH.CONTENT.8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.
● CCSS.MP1 Make sense of problems and persevere in solving them
● CCSS.MP5 Use appropriate tools strategically
● CCSS.MP6 Attend to precision.
● CCSS.MP7 Look for and make use of structure</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● understand that there are multiple ways to represent numbers
● use their study of exponent properties as a basis for advanced study of exponents in Algebra 1</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Exponential notation is an efficient way of expressing numbers.</td><td>ESSENTIAL QUESTIONS
● What is the purpose of exponents?
● How do you simplify expressions using the laws of exponents?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● product, quotient, and power rules of exponents.
● the meaning of negative exponents and zero exponents.</td><td>Students will be skilled at…
● simplifying expressions using the product, quotient, and power rules of exponents.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Communication
● Critical Thinking</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 6: Ratios, Proportions, and Percents

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="8">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will review ratios, proportions, and percents.

Content Standards:
● CCSS.MATH.CONTENT.7.RP.A.2 Recognize and represent proportional relationships between quantities.
● CCSS.MATH.CONTENT.7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
● CCSS.MP1 Make sense of problems and persevere in solving them
● CCSS.MP2 Reason abstractly and quantitatively.
● CCSS.MP4 Model with mathematics
● CCSS.MP5 Use appropriate tools strategically
● CCSS.MP6 Attend to precision.
● CCSS.MP7 Look for and make use of structure</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● be an informed consumer when determining costs related to discounts, tax, and tip.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Proportional relationships express how quantities change in relationship to each other.
● Proportions are a tool for calculating percentages and finding missing pieces of information.
● Real life data is often represented as percentages.</td><td>ESSENTIAL QUESTIONS
● What kinds of relationships can proportions represent?
● How can solving percentages be applied to real world situations?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● ratios and proportions
● the equivalency of fractions, decimals, and percents.
● mark-up, tax, and discount.</td><td>Students will be skilled at…
● determining if two ratios create a proportion.
● solving proportions.
● using proportions to solve problems.
● solving percent equations.
● solving word problems using percents. This includes, but is not limited to, mark-up, tax, discount, and tip.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2"></td><td>● Communication
● Critical Thinking</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Fundamentals of Mathematics (I & II)
Unit 7: Graphing & Writing Linear Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more extra study of fundamental mathematics topics prior to taking Algebra 1. In this unit, students will learn how to graph and write linear equations.

Content Standards:

- CCSS.MATH.CONTENT.6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
- CCSS.HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP4 Model with mathematics
- CCSS.MP5 Use appropriate tools strategically
- CCSS.MP7 Look for and make use of structure

Transfer

Students will be able to independently use their learning to…

- see the connections between equations and graphs

Meaning

ENDURING UNDERSTANDINGS

- Slope is a constant rate of change.
- Equations describe the association between two quantities.
- Every line on a coordinate plane consists of an infinite number points represented by an equation.

ESSENTIAL QUESTIONS

- How can you recognize a linear equation?
- How can the slope of a line be used to describe the line? How can you describe the graph of y = mx +b? and Ax + By = C.
- How are equations and graphs related?

Acquisition

Students will understand…

- ordered pair, coordinate plane, origin, x-axis, y-axis, and quadrants.
- the slope of a line as rate of change
- the slope-intercept and standard forms of a linear equation.
- the relationships between a linear equation, the graph of the linear equation and the solution to the linear equation.

Students will be skilled at…

- plotting points on the coordinate plane.
- finding a solution to a linear equation by creating a table of values.
- finding the slope of a line given a graph, 2 points, and a linear equation.
- graphing linear equations given an equation in slope-intercept form and standard form.
- writing a linear equation from the graph of a line

Used in Content Area Standards	*21st Century Skills*
	● Communication ● Critical Thinking

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Geometry

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Geometric Structure	● Postulates related to points, lines, and planes ● Distance between two points ● Midpoint of a segment. ● Properties of perpendicular lines ● Inductive reasoning ● Conditional statements and converses ● Proofs involving segment addition, angle addition, congruence, supplementary and complementary angles, and right angles ● Angle pairs including those formed by parallel lines and transversals ● Slopes of lines ● Parallel and perpendicular lines ● Characteristics of special pairs of angles	● Geometry is the mathematics of spatial relationships. ● Points, lines, and planes are the undefined terms that make up the foundation of geometry. ● Basic geometric concepts are used to determine relationships between angles and lines. ● Proofs are written to validate statements using given information, a conclusion, and deductive reasoning. ● Inductive reasoning is used to make conjectures in geometry.	● Make conjectures about lines and angles and determine the validity of those conjectures using logic. ● Find midpoint, length of a segment, measures of angles, and slopes of lines and use them to investigate geometric relationships. ● Use deductive reasoning to prove a statement involving segment addition, angle addition, congruence, supplementary and complementary angles, and right angles ● Identify and model points, lines, and planes. ● Apply the segment addition and angle addition postulate ● Find all angle pairs, including the ones formed by a transversal on a set of parallel lines, and use them to solve problems. ● Recognize the characteristics of parallel and perpendicular lines ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Unit 2: Congruence	● Triangle congruence and its corresponding parts. ● Properties of isosceles and equilateral triangles. ● Perpendicular bisectors, angle bisectors, and midsegments in triangles. ● Measures of the interior and exterior angles of a polygon.	● Unique properties of triangles and quadrilaterals can be identified. ● Triangles are fundamental structural elements. ● Corresponding parts of congruent triangles are congruent. ● Proofs are written to validate statements using given	● Name and use corresponding parts of congruent triangles. ● Recognize and apply properties of triangles and other polygons. ● Recognize and apply properties of quadrilaterals. ● Identify relationships between sides and angles of triangles. ● Justify one's reasoning by use of informal

	● Properties of quadrilaterals	information, a conclusion, and deductive reasoning. ● Inductive reasoning is used to make conjectures in geometry.	proofs, justifications, logical reasoning, and proof of evidence
Unit 3: Similarity	● Similar polygons ● Similar triangles ● Scale factors	● Right triangles are highly useful in applications. ● Similar polygons have ratios, proportions, and scale factors that are used to describe and compare quantities in real world applications.	● Solve problems using the properties of similar triangles and similar polygons. ● Apply the Pythagorean Theorem. ● Identify and apply patterns from right triangles to solve meaningful problems. ● Develop, apply, and justify triangle similarity relationships. ● Use scale factors to solve problems. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Unit 4: Measurement	● Central angles, arcs, inscribed angles, and tangents of a circle. ● Sector of a circle ● Equation of a circle ● Lateral area, surface area, and volume of various solid figures ● Properties of similar solids ● Arc length ● Areas of polygons	● The measurements of geometric figures can be calculated using a variety of strategies. ● A change in one dimension of an object results in predictable changes in area and or volume.	● Describe the relationships between central angles, arcs, and inscribed angles in a circle. ● Find areas of polygons, composite figures, circles and sectors. ● Solve problems using the properties of circles. ● Recognize the diameter, radius, and center of a circle from its equation. ● Find arc length. ● Use areas of 2-D objects as well as lateral areas, surface areas, and volumes of various solid figures. ● Use properties of similar solids to solve real world problems. ● Perform unit conversions for square and cubic units. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence

Windham School District Curriculum
Geometry
Unit 1: Geometric Structure

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also learn how to justify their answers both formally and informally.

Content Standards:

- CCSS.HSG.CO.1. Know precise definitions of angle, circle, perpendicular line, parallel, line, and line segment, based on undefined notions of point, line, distance along a line, and distance around a circular arc.
- CCSS.HSG.CO.9. Prove theorems about lines and angles. Theorems include; vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
- CCSS.HSG.CO.12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

Transfer

Students will be able to independently use their learning to…

- see geometry in all structures
- create conclusions using reasoning
- communicate their findings both formally and informally

Meaning

ENDURING UNDERSTANDINGS

- Geometry is the mathematics of spatial relationships.
- Points, lines, and planes are the undefined terms that make up the foundation of geometry.
- Basic geometric concepts are used to determine relationships between angles and lines.
- Proofs are written to validate statements using given information, a conclusion, and deductive reasoning.
- Inductive reasoning is used to make conjectures in geometry.

ESSENTIAL QUESTIONS

- What are the undefined terms in geometry and how can we represent them?
- How do you connect definitions, postulates, logical reasoning, and theorems in developing mathematical proofs? How do you use slopes of lines to determine geometric relationships?
- How are basic geometric concepts used to determine relationships between angles and lines?

Acquisition

Students will understand…

- basic postulates of points, lines, and planes.
- the distance between two points
- midpoint of a segment.

Students will be skilled at…

- making conjectures about lines and angles and determining the validity of those conjectures using logic.

● CCSS.HSG.GPE.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). ● CCSS.HSG.GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. ● CCSS.HSG.MG.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). ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning	● the characteristics of special pairs of angles. ● the properties of perpendicular lines. ● conjectures based on inductive reasoning ● conditional statements and converses. ● angle pairs formed by parallel lines and transversals. ● slopes of lines and use slopes to identify parallel and perpendicular lines. ● basic proofs including segments and angles.	● identifying and modeling points, lines, and planes. ● applying the segment addition postulate and the angle addition postulate in solving applications. ● finding all angle pairs, including the ones formed by a transversal on a set of parallel lines, and using them to solve problems. ● recognizing the characteristics of parallel and perpendicular lines ● finding midpoint and length of a segment, measures of angles, and slopes of lines and using them to investigate geometric relationships. ● using deductive reasoning to prove a statement involving segment addition, angle addition, congruence, supplementary and complementary angles, and right angles. ● justifying one's reasoning by use of formal and informal proofs, justifications, logical reasoning, inductive reasoning, deductive reasoning and proof of evidence.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Geometry
Unit 2: Congruence

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore congruence within geometric shapes.

Content Standards:

- CCSS.HSG.CO.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
- CCSS.HSG.CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- CCSS.HSG.CO.10. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
- CCSS.HSG.CO.11. Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Transfer

Students will be able to independently use their learning to…

- apply the properties of geometric figures in real-life applications
- recognize congruent shapes using given information and properties.

Meaning

ENDURING UNDERSTANDINGS

- Unique properties of triangles and quadrilaterals can be identified.
- Triangles are fundamental structural elements.
- Corresponding parts of congruent triangles are congruent.
- Proofs are written to validate statements using given information, a conclusion, and deductive reasoning.
- Inductive reasoning is used to make conjectures in geometry.

ESSENTIAL QUESTIONS

- What does it mean when two triangles are congruent?
- What are the ways to prove two triangles are congruent?
- What are the relationships between the sides and angles of triangles?
- What are the properties of parallelograms and how can you apply them to solve problems?

Acquisition

Students will understand…

- triangle congruence and its corresponding parts.
- properties of isosceles and equilateral triangles.
- properties of perpendicular bisectors, angle bisectors, and mid-segments in

Students will be skilled at…

- naming and using corresponding parts of congruent triangles.
- recognizing and applying properties of quadrilaterals.
- recognizing and applying properties of triangles and other polygons.

● CCSS.HSG. SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. ● CCSS.HSG. GPE.4. Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point on the circle centered at the origin and containing the point (0,2). ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning	triangles. ● the measures of the interior and exterior angles of a polygon. ● properties of quadrilaterals.	● identifying relationships between sides and angles of triangles. ● justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Perseverance

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Geometry
Unit 3: Similarity

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also study when structures are similar rather than congruent.

Content Standards:

- CC.HSG.CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- CC.HSG.CO.6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- CC.HSG.CO.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.
- b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- CC.HSG.SRT.2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- CC.HSG.SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Transfer

Students will be able to independently use their learning to…

- explain when structures are similar rather than congruent.
- apply properties of similarity to solve real-life problems.

Meaning

ENDURING UNDERSTANDINGS

- Right triangles are highly useful in applications.
- Similar polygons have ratios, proportions, and scale factors that are used to describe and compare quantities in real world applications.

ESSENTIAL QUESTIONS

- How can you use ratios to solve problems involving similar triangles?
- What are some patterns in right triangles and how can you apply those patterns to solve meaningful problems? In what ways can you prove two triangles are similar?
- How do transformations connect congruence and similarity?

Acquisition

Students will understand…

- the properties of similar polygons.
- when triangles are similar.
- scale factors.

Students will be skilled at…

- solving problems using the properties of similar polygons.
- applying the Pythagorean Theorem to solve real-world problems.
- identifying and applying patterns from right triangles to solve meaningful problems.

● CC.HSG.SRT.4. Prove theorems about triangles. Theorems include; a line parallel to one side of a triangle drives the other two proportionally, and conversely; the Pythagorean Theorem proved using triangles similarity. ● CC.HSG.SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. ● CC.HSG.SRT.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. ● CC.HSG.SRT.7. Explain and use the relationship between the sine and cosine of complementary angles. ● CC.HSG.SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● developing and justifying triangle similarity relationships. ● using scale factor to solve problems. ● using similar triangles in solving problems. ● justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Geometry
Unit 4: Measurement

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also explore the various ways to measure objects including perimeter and area of two-dimensional figures as well as surface area and volume of three-dimensional objects.

Content Standards:

- CC.HSG.CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. CC.HSG.C.1. Prove that all circles are similar.
- CC.HSG.C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- CC.HSG.C.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
- CC.HSG.GMD.1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments. CC.HSG.GMD.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Transfer

Students will be able to independently use their learning to…

- apply appropriate measurement tools when solving real life problems

Meaning

ENDURING UNDERSTANDINGS

- The measurements of geometric figures can be calculated using a variety of strategies.
- A change in one dimension of an object results in predictable changes in area and or volume.

ESSENTIAL QUESTIONS

- How can we use lateral area, surface area, and volume to solve real world problems?

Acquisition

Students will understand…

- areas of polygons.
- areas and sectors of circles.
- lateral areas, surface areas, and volumes of various solid figures.
- properties of similar solids.
- arc length of a circle
- central angles, arcs, inscribed angles, and tangents of a circle
- equation of a circle

Students will be skilled at…

- finding areas of polygons, composite figures, circles, and sectors.
- using scale factors of similar figures.
- Describing the relationships between central angles, arcs, and inscribed angles in a circle.
- Solving problems using the properties of circles.
- Recognizing the diameter, radius, and center of a circle from its equation.

● CC.HSG.MG.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) ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning.		● Finding arc length. ● Using areas of 2-D objects as well as lateral areas, surface areas, and volumes of various solid figures. ● Using properties of similar solids to solve real world problems. ● Performing unit conversions for square and cubic units. ● justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication ● Perseverance ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: CP Geometry

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Geometric Structure	● Points, lines, and planes ● Distance between two points ● Midpoint of a segment ● Properties of perpendicular lines ● Inductive reasoning ● Deductive reasoning ● Angle pairs including those formed by parallel lines and transversals ● Parallel and perpendicular lines ● Complementary and supplementary angles	● Geometry is the mathematics of spatial relationships. ● Points, lines, and planes are the undefined terms that make up the foundation of geometry. ● Basic geometric concepts are used to determine relationships between angles and lines. ● Proofs are written to validate statements using given information, a conclusion, and deductive reasoning. ● Inductive reasoning is used to make conjectures in geometry.	● Make conjectures about lines and angles and determine the validity of those conjectures using logical reasoning. ● Develop proofs involving segment addition, angle addition, congruence, supplementary and complementary angles, vertical angles and right angles ● Find midpoint, length of a segment, measures of angles, and slopes of lines and use them to investigate geometric relationships. ● Use deductive reasoning to prove a statement. ● Apply the segment addition and angle addition postulates. ● Find all angle pairs, including the ones formed by a transversal on a set of parallel lines, and use them to solve problems. ● Recognize the characteristics of parallel and perpendicular lines and write the equations of these lines. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Unit 2: Congruence	● Triangle congruence and corresponding parts ● Properties of isosceles and equilateral triangles ● Perpendicular bisectors, angle bisectors, and midsegments in triangles ● Measures of the interior and exterior angles of a polygon	● Unique properties of quadrilaterals can be identified. ● Triangles are fundamental structural elements. ● Corresponding parts of congruent triangles are congruent. ● Proofs are written to validate statements using given	● Name and use corresponding parts of congruent triangles. ● Prove triangle congruence. ● Identify relationships between sides and angles of triangles. ● Recognize and apply properties of triangles and quadrilaterals. ● Find interior and exterior angles of polygons.Use coordinates in conjunction with geometric properties to determine the specific quadrilateral.

	● Properties of quadrilaterals ● Congruence transformations	information, a conclusion, and deductive reasoning. ● Inductive reasoning is used to make conjectures in geometry.	● Understand congruence in terms of transformations. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Unit 3: Similarity	● Similar polygons ● Similar triangles ● Scale factors ● Special right triangles ● Triangle similarity relationships ● Trigonometric ratios	● Properties and patterns of right triangles can be applied to real world applications. ● Similar polygons have ratios, proportions, and scale factors that are used to describe and compare quantities in real world applications.	● Solve problems using the properties of similar polygons. ● Apply the Pythagorean Theorem. ● Identify and apply patterns from right triangles to solve meaningful problems. ● Develop, apply, and justify triangle similarity relationships including trigonometric ratios. ● Use scale factor to solve problems. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Unit 4: Measurement	● Central angles, arcs, inscribed angles, and tangents to circles ● Sector of a circle ● Equation of a circle and its parts ● Lateral area, surface area, and volume of various solid figures ● Properties of similar solids ● Arc length ● Degrees and radians	● The measurements of geometric figures can be calculated using a variety of strategies. ● A change in one dimension of an object results in predictable changes in area and or volume.	● Describe the relationships between central angles, arcs, and inscribed angles in a circle. ● Find areas of polygons, composite figures, circles and sectors. ● Solve problems using the properties of circles. ● Recognize the diameter, radius, and center of a circle from its equation. ● Find the arc length. ● Use areas and volumes to solve real world problems. ● Use properties of similar solids to solve real world problems. ● Perform unit conversions for square and cubic units. ● Convert between degrees and radians. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.

Windham School District Curriculum
CP Geometry
Unit 1: Geometric Structure

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also learn how to justify their answers both formally and informally.

- CC.HSG.CO.1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on undefined notions of point, line, distance along a line, and distance around a circular arc.
- CC.HSG.CO.9. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
- CC.HSG. CO.12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
- CC.HSG.GPE.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric

Transfer

Students will be able to independently use their learning to…

- see geometry in all structures
- create conclusions using reasoning
- communicate their findings both formally and informally

Meaning

ENDURING UNDERSTANDINGS

- Geometry is the mathematics of spatial relationships.
- Points, lines, and planes are the undefined terms that make up the foundation of geometry.
- Basic geometric concepts are used to determine relationships between angles and lines.
- Proofs are written to validate statements using given information, a conclusion, and deductive reasoning.
- Inductive reasoning is used to make conjectures in geometry.

ESSENTIAL QUESTIONS

- What are the undefined terms in geometry and how can we represent them?
- How do you connect definitions, postulates, logical reasoning, and theorems in developing mathematical proofs?
- How do you use slopes of lines to determine geometric relationships?
- How are basic geometric concepts used to determine relationships between angles and lines?

Acquisition

Students will understand…

- Points, lines, and planes
- Distance between two points

Students will be skilled at…

- Making conjectures about lines and angles and determining the validity of those conjectures using

problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). ● CC.HSG.GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g. using the distance formula. ● CC.HSG. MG.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). ● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others. ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning	● Midpoint of a segment ● Properties of perpendicular lines ● Inductive reasoning ● Deductive reasoning ● Angle pairs including those formed by parallel lines and transversals (adjacent, linear pairs, vertical, alternate interior, alternate exterior, consecutive interior, corresponding) ● Parallel and perpendicular lines ● Complementary and supplementary angles	logical reasoning. ● Developing proofs involving segment addition, angle addition, congruence, supplementary and complementary angles, vertical angles, and right angles ● Finding midpoint, length of a segment, measures of angles, and slopes of lines and using them to investigate geometric relationships. ● Using deductive reasoning to prove a statement. ● Applying the segment addition and angle addition postulates ● Finding all angle pairs, including the ones formed by a transversal on a set of parallel lines, and using them to solve problems**.** ● Recognizing the characteristics of parallel and perpendicular lines and writing the equations of these lines. ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Geometry
Unit 2: Congruence

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore congruence within geometric shapes.

- CC.HSG.CO.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
- CC.HSG.CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- CC.HSG.CO.10. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180o; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
- CC.HSG.CO.11. Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
- CC.HSG.SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Transfer

Students will be able to independently use their learning to…

- apply the properties of geometric figures in real-life applications
- recognize congruent shapes using given information and properties.

Meaning

ENDURING UNDERSTANDINGS

- Unique properties of quadrilaterals can be identified
- Triangles are fundamental structural elements.
- Corresponding parts of congruent triangles are congruent.
- Proofs are written to validate statements using given information, a conclusion, and deductive reasoning.
- Inductive reasoning is used to make conjectures in geometry.

ESSENTIAL QUESTIONS

- What does it mean when two polygons are congruent?
- What are the ways to prove two triangles are congruent?
- What are the relationships between the sides and angles of triangles?
- What are the properties of quadrilaterals and how can you apply them to solve problems?

Acquisition

Students will understand…

- Triangle congruence and its corresponding parts.
- Properties of isosceles and equilateral triangles.
- Perpendicular bisectors, angle bisectors, and midsegments in triangles.

Students will be skilled at…

- Naming and using corresponding parts of congruent triangles.
- Proving triangle congruence.
- Identifying relationships between sides and angles of triangles.
- Recognizing and applying properties of triangles and quadrilaterals.

● CC.HSG.GPE.4. Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0,2). ● CC.HSG.GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.	● Measures of the interior and exterior angles of a polygon. ● Properties of quadrilaterals. ● Congruence transformations	● Finding interior and exterior angles of polygons. ● Using coordinates in conjunction with geometric properties to determine the specific quadrilateral. ● Understanding congruence in terms of transformations. ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Geometry
Unit 3: Similarity

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also study when structures are similar rather than congruent.

- CC.HSG.CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- CC.HSG.CO.6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a give rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- CC.HSG.CO.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.
- b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- CC.HSG.SRT.2. Given two figures use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- CC.HSG.SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. CC.HSG.SRT.4. Prove theorems about triangles. Theorems include: a line parallel to one side of

Transfer

Students will be able to independently use their learning to…

- explain when structures are similar rather than congruent.
- apply properties of similarity to solve real-life problems.

Meaning

ENDURING UNDERSTANDINGS

- Properties and patterns of right triangles can be applied to real world applications.
- Similar polygons have ratios, proportions, and scale factors that are used to describe and compare quantities in real world applications.

ESSENTIAL QUESTIONS

- How can you use ratios to solve problems involving similar triangles?
- What are some patterns in right triangles and how can you apply those patterns to solve meaningful problems?
- In what ways can you prove two triangles are similar?

Acquisition

Students will know…

- Similar polygons
- Similar triangles
- Scale factors
- Special right triangles
- Triangle similarity relationships
- Trigonometric ratios

Students will be skilled at…

- Solving problems using the properties of similar polygons.
- Applying the Pythagorean Theorem.
- Identifying and applying patterns from right triangles to solve meaningful problems.
- Developing, applying, and justifying triangle similarity relationships including trigonometric ratios.
- Using scale factors to solve problems.

a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. ● CC.HSG.SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. ● CC.HSG.SRT.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. ● CC.HSG.SRT.7. Explain and use the relationship between the sine and cosine of complementary angles. CC.HSG.SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.		● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Geometry
Unit 4: Measurement

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also explore the various ways to measure objects including perimeter and area of two-dimensional figures as well as surface area and volume of three-dimensional objects.

- CC.HSG.CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
- CC.HSG.C.1. Prove that all circles are similar.
- CC.HSG.C2. Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
- CC.HSG.C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- CC.HSG.C.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. CC.HSG.GMD.1. Give an informal argument for the formulas for cylinders, pyramids, cones, and spheres to solve problems.

Transfer

Students will be able to independently use their learning to…

- apply appropriate measurement tools when solving real life problems

Meaning

ENDURING UNDERSTANDINGS

- The measurements of geometric figures can be calculated using a variety of strategies.
- A change in one dimension of an object results in predictable changes in area and or volume.

ESSENTIAL QUESTIONS

- What is the relationship between central angles, arcs, and inscribed angles in a circle?
- How can you use the area of polygons to solve real life problems?
- How can we use lateral area, surface area, and volume to solve real world problems?

Acquisition

Students will know…

- Central angles, arcs, inscribed angles, and tangents to circles.
- Sector of a circle
- Equation of a circle and its parts
- Lateral area, surface area, and volume of various solid figures
- Properties of similar solids
- Arc length
- Degrees and radians

Students will be skilled at…

- Describing the relationships between central angles, arcs, and inscribed angles in a circle.
- Finding areas of polygons, composite figures, circles and sectors.
- Solving problems using the properties of circles.
- Recognizing the diameter, radius, and center of a circle from its equation.
- Finding arc length.
- Using areas and volumes to solve real

● CC.HSG. MG.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) ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		world problems.. ● Using properties of similar solids to solve real world problems. ● Performing unit conversions for square and cubic units. ● Converting between degrees and radians ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Honors Geometry

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Geometric Structure	● points, lines, and planes ● Distance between two points ● Midpoint of a segment ● Properties of perpendicular lines ● Inductive reasoning ● Deductive reasoning ● Angle pairs including those formed by parallel lines and transversals ● Parallel and perpendicular lines ● Distance between parallel lines and a point and a line	● Geometry is the mathematics of spatial relationships. ● Points, lines, and planes are the undefined terms that make up the foundation of geometry. ● Basic geometric concepts are used to determine relationships between angles and lines. ● Proofs are written to validate statements using given information, a conclusion, and deductive reasoning. ● Inductive reasoning is used to make conjectures in geometry.	● Make conjectures about lines and angles and determine the validity of those conjectures using logic. ● Develop proofs involving segment addition, angle addition, congruence, supplementary and complementary angles, vertical angles, and right angles. ● Use midpoint, length of a segment, measures of angles, and slopes of lines to investigate geometric relationships. ● Use deductive reasoning to prove a statement. ● Apply the segment addition and angle addition postulates. ● Find all angle pairs, including ones formed by a transversal on a set of parallel lines, and use them to solve problems. ● Recognize the characteristics of parallel and perpendicular lines and write the equations of these lines. ● Find area of triangles using the distance formula to find the needed lengths ● Find the distance between parallel lines and a point and a line ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence.
Unit 2: Congruence	● Triangle congruence and its corresponding parts. ● Properties of isosceles and equilateral triangles.	● Unique properties of quadrilaterals can be identified. ● Triangles are fundamental structural elements.	● Name and use corresponding parts of congruent triangles. ● Prove triangle congruence. ● Recognize and apply properties of triangles, quadrilaterals, and regular polygons.

	● Perpendicular bisectors, angle bisectors, medians, altitudes and midsegments in triangles. ● Measures of the interior and exterior angles of a polygon, along with number of sides and diagonals.. ● Properties of quadrilaterals ● perpendicular bisectors, angle bisectors, medians, and altitudes of triangles as found on a coordinate grid	● Corresponding parts of congruent triangles are congruent. ● Proofs are written to validate statements using given information, a conclusion, and deductive reasoning. ● Inductive reasoning is used to make conjectures in geometry.	● Identify relationships between sides and angles of triangles. ● Find the number of sides, number of diagonals, interior and exterior angles of regular polygons. ● Use coordinates to construct perpendicular bisectors, angle bisectors, medians, and altitudes to explore more relationships. ● Use coordinates in conjunction with geometric properties to determine the specific quadrilateral. ● Explore the relationships of special segments in triangles. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Unit 3: Similarity	● Similar polygons ● Similar triangles ● Scale factors ● Special right triangles ● Triangle similarity relationships ● Trigonometric ratios ● Law of Sines and Cosines	● Right triangles are highly useful in applications. ● Similar polygons have ratios, proportions, and scale factors that are used to describe and compare quantities in real world applications.	● Solve problems using the properties of similar polygons. ● Apply the Pythagorean Theorem. ● Identify and apply patterns from right triangles to solve meaningful problems. ● Develop, apply, and justify triangle similarity relationships including trigonometric ratios and the law of sines and cosines ● Use scale factor to solve problems ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Unit 4: Measurement	● Central angles, arcs, inscribed angles, and tangents to circles. ● Sector of a circle ● Equation of a circle and its parts ● Lateral area, surface area, and volume of various	● The measurements of geometric figures can be calculated using a variety of strategies. ● A change in one dimension of an object results in predictable changes in area and or volume.	● Describe the relationships between central angles, arcs, and inscribed angles in a circle. ● Find areas of polygons, composite figures, circles and sectors. ● Solve problems using the properties of circles. ● Recognize the diameter, radius, and center of a circle from its equation.

	solid figures ● Properties of similar Solids ● Arc length ● Degrees and radians		● Find arc length. ● Use scale factor of similar figures to find areas & volumes. ● Use areas and volumes to solve real world problems. ● Use properties of similar solids to solve real world problems. ● Perform unit conversions for square and cubic units. ● Convert between degrees and radians. ● Justify one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence

Windham School District Curriculum
Honors Geometry
Unit 1: Geometric Structure

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also learn how to justify their answers both formally and informally.

Content Standards:

- CC.HSG.CO.1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on undefined notions of point, line, distance along a line, and distance around a circular arc.
- CC.HSG.CO.9. Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
- CC.HSG. CO.12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment;

Transfer

Students will be able to independently use their learning to…

- see geometry in all structures
- create conclusions using reasoning
- communicate their findings both formally and informally

Meaning

ENDURING UNDERSTANDINGS

- Geometry is the mathematics of spatial relationships.
- Points, lines, and planes are the undefined terms that make up the foundation of geometry.
- Basic geometric concepts are used to determine relationships between angles and lines.
- Proofs are written to validate statements using given information, a conclusion, and deductive reasoning.
- Inductive reasoning is used to make conjectures in geometry.

ESSENTIAL QUESTIONS

- What are the undefined terms in geometry and how can we represent them?
- How do you connect definitions, postulates, logical reasoning, and theorems in developing mathematical proofs?
- How do you use slopes of lines to determine geometric relationships?
- What is the relationship between square feet, square inches, and square yards?
- How are basic geometric concepts used to determine relationships between angles and lines?

Acquisition

Students will understand…

- points, lines, and planes
- Distance between two points

Students will be skilled at…

- Making conjectures about lines and angles and determining the validity of those conjectures using logic.

copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line. ● CC.HSG.GPE.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). ● CC.HSG.GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g. using the distance formula. ● CC.HSG. MG.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).	● Midpoint of a segment ● Properties of perpendicular lines ● Inductive reasoning ● Deductive reasoning ● Angle pairs including those formed by parallel lines and transversals ● Parallel and perpendicular lines ● Distance between parallel lines and a point and a line	● Developing proofs involving segment addition, angle addition, congruence, supplementary and complementary angles, vertical angles, and right angles. ● Using midpoint, length of a segment, measures of angles, and slopes of lines to investigate geometric relationships. ● Using deductive reasoning to prove a statement. ● Applying the segment addition and angle addition postulate ● Finding all angle pairs, including ones formed by a transversal on a set of parallel lines, and using them to solve problems ● Recognizing the characteristics of parallel and perpendicular lines and write the equations of these lines ● Finding the area of triangles using the distance formula to find the required information ● Find the distance between parallel lines as well as a point and a line ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others. ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Geometry
Unit 2: Congruence

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore congruence within geometric shapes.

Content Standards:

- CC.HSG.CO.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
- CC.HSG.CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
- CC.HSG.CO.10. Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180o; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
- CC.HSG.CO.11. Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Transfer

Students will be able to independently use their learning to…

- apply the properties of geometric figures in real-life applications
- recognize congruent shapes using given information and properties.

Meaning

ENDURING UNDERSTANDINGS

- Unique properties of quadrilaterals can be identified.
- Triangles are fundamental structural elements.
- Corresponding parts of congruent triangles are congruent.
- Proofs are written to validate statements using given information, a conclusion, and deductive reasoning.
- Inductive reasoning is used to make conjectures in geometry.

ESSENTIAL QUESTIONS

- What does it mean when two polygons are congruent?
- What are the ways to prove two triangles are congruent?
- What are the special segments and corresponding points of concurrency with relation to triangles?
- What are the relationships between the sides and angles of triangles?
- What are the properties of quadrilaterals and how can you apply them to solve problems?

Acquisition

Students will understand…

- Triangle congruence and its corresponding parts
- Properties of isosceles and equilateral triangles

Students will be skilled at…

- Naming and using corresponding parts of congruent triangles
- Proving triangle congruence
- Recognizing and applying properties of triangles, quadrilaterals and regular polygons

● CC.HSG.SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. ● CC.HSG.GPE.4. Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0,2). ● CC.HSG.GPE.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning	● Perpendicular bisectors, angle bisectors, medians, altitudes and midsegments in triangles ● Measures of the interior and exterior angles of a polygon, along with number of sides and diagonals. ● Properties of quadrilaterals ● How to create perpendicular bisectors, medians, and altitudes of triangles on a coordinate grid and explore the resulting relationships	● Identifying relationships between sides and angles of triangles ● Finding the number of sides, number of diagonals, interior and exterior angles of regular polygons. ● Using coordinates to construct perpendicular bisectors, angle bisectors, medians, and altitudes to explore relationships ● Using coordinates in conjunction with geometric properties to determine the specific quadrilateral. ● Exploring relationships of special segments in triangles. ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Geometry
Unit 3: Similarity

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also study when structures are similar rather than congruent.

Content Standards:

- CC.HSG.CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- CC.HSG.CO.6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a give rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- CC.HSG.CO.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.
- b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- CC.HSG.SRT.2. Given two figures use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
- CC.HSG.SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. CC.HSG.SRT.4. Prove theorems about triangles. Theorems include: a line parallel to one

Transfer

Students will be able to independently use their learning to…

- Explain when structures are similar rather than congruent.
- Apply properties of similarity to solve real-life problems.

Meaning

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
● Right triangles are highly useful in applications. ● Similar polygons have ratios, proportions, and scale factors that are used to describe and compare quantities in real world applications.	● How can you use ratios to solve problems involving similar triangles? ● What are some patterns in right triangles and how can you apply those patterns to solve meaningful problems? ● In what ways can you prove two triangles are similar?

Acquisition

Students will understand…	*Students will be skilled at…*
● Similar polygons ● Similar triangles ● Scale factors ● Special right triangles ● Triangle similarity relationships ● Trigonometric ratios ● Law of Sines and Cosines	● Solving problems using the properties of similar polygons. ● Applying the Pythagorean Theorem. ● Identifying and applying patterns from right triangles to solve meaningful problems. ● Developing, applying, and justifying triangle similarity relationships including trigonometric ratios and the laws of sines and cosines.

side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. ● CC.HSG.SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. ● CC.HSG.SRT.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. ● CC.HSG.SRT.7. Explain and use the relationship between the sine and cosine of complementary angles. CC.HSG.SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ● CCSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		● Using scale factors to solve problems. ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Geometry
Unit 4: Measurement

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more formal study of Geometry. In this unit, students explore the structure of Geometry. They will also explore the various ways to measure objects including perimeter and area of two-dimensional figures as well as surface area and volume of three-dimensional objects.

Content Standards:

- CC.HSG.CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
- CC.HSG.C.1. Prove that all circles are similar.
- CC.HSG.C2. Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
- CC.HSG.C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- CC.HSG.C.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. CC.HSG.GMD.1. Give an informal argument for the formulas for cylinders, pyramids, cones, and spheres to solve problems.

Transfer

Students will be able to independently use their learning to…

- Apply appropriate measurement tools when solving real life problems

Meaning

ENDURING UNDERSTANDINGS

- The measurements of geometric figures can be calculated using a variety of strategies.
- A change in one dimension of an object results in predictable changes in area and or volume.

ESSENTIAL QUESTIONS

- What is the relationship between central angles, arcs, and inscribed angles in a circle?
- How can you use the area of polygons to solve real life problems?
- How can we use lateral area, surface area, and volume to solve real world problems?

Acquisition

Students will understand…

- Central angles, arcs, inscribed angles, and tangents of circles.
- Sector of a circle
- Equation of a circle and its parts
- Lateral area, surface area, and volume of various solid figures
- Properties of similar solids
- Arc length
- Degrees and radians

Students will be skilled at…

- Describing the relationships between central angles, arcs, and inscribed angles in a circle.
- Finding areas of polygons, composite figures, circles and sectors.
- Solving problems using the properties of circles.
- Recognizing the diameter, radius, and center of a circle from its equation.
- Finding arc length.
- Using scale factor of similar figures to find

● CC.HSG. MG.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) ● CSS.MP1 Make sense of problems and persevere in solving them ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others ● CCSS.MP4 Model with mathematics ● CCSS.MP5 Use appropriate tools strategically ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure ● CCSS.MP8 Look for and express regularity in repeated reasoning		area and volumes ● Using areas and volumes to solve real world problems. ● Using properties of similar solids to solve real world problems. ● Performing unit conversions for square and cubic units. ● Converting between degrees and radians ● Justifying one's reasoning by use of informal proofs, justifications, logical reasoning, and proof of evidence
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: CP Precalculus

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Relations, Functions, and Graphs	● Characteristics of a function ● Domain and range of a function ● Inverses of relations and functions ● Higher degree polynomial functions ● Roots of polynomial equations ● Rigid and non-rigid graphical transformations	● Characteristics within and across families of functions define the shape of a graph and application. ● Relations and functions can be represented numerically, graphically, algebraically and/or verbally.	● Review writing equations of linear quadratic functions ● Write equations of circles ● Graph higher degree polynomials and other functions ● Graphically manipulate functions and expressions to convey meaning ● Determine zeros, domain, and range of polynomial functions ● Find the inverse of a function ● Graph a piecewise defined function ● Interpret results and reflect on the reasonableness of their solutions ● Model problems algebraically, graphically, and with table and charts ● Use technology appropriately to solve mathematical problems. ● Identify functions given tables, equations, or graphs
Unit 2: Rational Functions	● Graphs of Rational Functions ● Horizontal and Vertical Asymptotes ● Non-Linear and Rational Inequalities	● The zeros and undefined values in the equation of a rational function determine the shape of the graph, including holes and asymptotes	● Graph rational functions by determining domain restrictions, horizontal and vertical asymptotes, x- and y-intercepts, holes, and additional points or information ● Determine solution sets for non-linear and rational inequalities algebraically and graphically ● Interpret results and reflect on reasonableness of their solutions ● Model problems algebraically, graphically, and with table and charts ● Use technology appropriately to solve mathematical problems ● Attend to precision when graphing the key features of a rational function
Unit 3: Exponential and Logarithmic Functions	● Logarithmic and exponential functions and their graphs ● Exponential functions with base e, (aka natural base) and logarithmic functions with base e (aka natural logarithm or ln) ● Exponential functions with base 10 and logarithmic	● Logarithms and exponents have corresponding properties. ● The function $y = e^x$ and $y = \ln x$ are inverse functions.	● Graph logarithmic and exponential functions ● Model real world applications functions with exponential and logarithmic expressions ● Identify common logarithms and natural logarithms and determine their base ● Solve expressions and equations where the variable is the exponent ● Make a change of base using the definition of logarithm ● Interpret results and reflect on reasonableness of their solutions and others

	functions with base 10 (aka common logarithm or log) ● Real-world applications involving logarithmic and exponential functions. ● Properties of logarithms		● Use technology appropriately to solve mathematical problems ● Recognize patterns associated with properties of exponents to determine the analogous properties of logarithms
Unit 4: Trigonometric Functions	● Angles and Radian Measure ● Right Triangle Trigonometry ● Reference Angles ● Trigonometric Functions and their graphs ● Amplitude, Period, Phase Shift, and Vertical Shift ● Laws of Sines and Cosines ● Area of Triangles ● Trigonometric Identities and Equations	● Trigonometry can be used to solve triangles as well as model waves.	● Evaluate trigonometric functions of any angle. ● Use reference angles to evaluate trigonometric functions. ● Sketch graphs of sine, cosine, and tangent graphs and their respective inverses accurately and precisely. ● Solve real life problems using right triangle trigonometry and Laws of Sines and Cosines. ● Recognize and write trigonometric equations. ● Verify trigonometric identities. ● Use standard algebraic techniques to solve trigonometric equations. ● Use sum, difference, double angle, half-angle formulas to verify and solve trigonometric equations. ● Find the area of an oblique triangle using the law of sines or cosines or an appropriate technique. ● Use technology appropriately to solve mathematical problems ● Recognize patterns in amplitude, period, phase shift and vertical shift to generalize a formula for any trigonometric function
Unit 5: Conics	● Equations (in various forms) and graphs of ellipses , hyperbolas, and parabolas	● Conic sections can be distinguished by their equations. Not all conics are functions. ● Conics have valid and important applications in the real world including satellite dishes and ultrasonic equipment.	● Apply mathematical concepts and computation skills to real world situations involving conic sections ● Algebraically model a conic section ● Graph a conic section from an equation ● Recognize and solve for the different variables that represent characteristics of a conic section. ● Recognize structure and patterns associated with graphing ellipses, hyperbolas, and parabolas

Windham School District Curriculum
CP Precalculus
Unit 1: Relations, Functions, & Graphs

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students explore the connections between relations, functions, and their graphs..

Content Standards:

- CCSS.HSA.APR.2. Know and apply the Remainder Theorem.
- CCSS.HSA.APR.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the functions defined by the polynomial.
- CCSS.HSF.IF.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.
- CCSS.HSF.IF.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. CCSS.HSF.IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- CCSS.HSF .IF.6. Calculate and interpret the average rate of change of a function presented symbolically or as a table over a specified interval.
- CCSS.HSF.IF.7. Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases.

Transfer

Students will be able to independently use their learning to…

- describe the similarities and differences of characteristics of various functions
- recognize different functions as they exist in real-world scenarios
- use their knowledge of functions in their future study of calculus

Meaning

ENDURING UNDERSTANDINGS

- Characteristics within and across families of functions define the shape of a graph and application.
- Relations and functions can be represented numerically, graphically, algebraically and/or verbally.

ESSENTIAL QUESTIONS

- What attributes are important for defining and graphing a function or relation?
- How can the properties of functions be used to model and analyze real-world applications and quantitative relationships?

Acquisition

Students will understand…

- the characteristics of a function.
- the domain and range of a function.
- linear equations in standard form.
- the inverses of relations and functions.
- rigid and non-rigid graphical transformations.

Students will be skilled at…

- writing equations for linear and quadratic functions.
- graphing higher degree polynomials and other functions.
-
- graphically manipulating functions and expressions to convey meaning.
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● CCSS.HSF.BF.3Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x+k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. ● CCSS.HSF.FB.4. Find inverse functions. ● CCSS.HSN.NC.8. Extend polynomial identities to the complex numbers. ● CCSS.HSN.NC.9. Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. ● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others. ● CCSS.MP4 Model with mathematics. ● CCSS.MP5 Use appropriate tools strategically. ● CCSS.MP7 Look for and make use of structure.	● higher degree polynomial functions. ● the roots of polynomial equations.	● determining zeros, domain, and range of polynomial functions. ● finding the inverse of a function. ● graphing piecewise functions. ● interpreting results and reflecting on the reasonableness of their solutions and others. ● modeling problems algebraically, graphically, and with tables and charts. ● using technology appropriately to solve mathematical problems. ● distinguishing between types of functions given tables, equations, or graphs.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Precalculus
Unit 2: Rational Expressions & Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students explore rational functions including their characteristics, equations, and graphs.

Content Standards:

- CCSS.HSA.APR. Rewrite simple rational expressions in different forms.
- CCSS.HSA.APR.7. Understand the rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression: add, subtract, multiply, and divide rational expressions.
- CCSS.HSF.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.MP4 Model with mathematics.
- CCSS.MP5 Use appropriate tools strategically.

Transfer

Students will be able to independently use their learning to…

- model rational functions graphically and understand the connection in applications

Meaning

ENDURING UNDERSTANDINGS

- The zeros and undefined values in the equation of a rational function determine the shape of the graph including holes and asymptotes.

ESSENTIAL QUESTIONS

- What is a rational function and how do you graph it?
- How do you identify asymptotes and holes in the graphs of rational functions?
- How do the zeroes and undefined values help to find a solution set for nonlinear inequalities?

Acquisition

Students will understand…

- Graphs of Rational Functions.
- Horizontal and Vertical Asymptotes.
- Non-Linear and Rational Inequalities.

Students will be skilled at…

- Graphing rational functions by determining domain restrictions, horizontal and vertical asymptotes, x and y-intercepts, holes, and other critical points.
- interpreting results and reflecting on the reasonableness of their solutions and others.
- modeling problems algebraically, graphically, and with tables and charts.
- using technology appropriately to solve mathematical problems.
- attending to precision when graphing the key features of a rational function.

● CCSS.MP6 Attend to precision.		● Determining solution sets for non-linear and rational inequalities algebraically and graphically by looking for general methods and shortcuts.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Precalculus
Unit 3: Logarithmic & Exponential Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students study the exponential and logarithmic functions including properties and graphs.

Content Standards:

- CCSS.HSA.SSE.2. Use the structure of an expression to identify ways to rewrite it.
- CCSS.HSA.SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- CCSS.HSF.BF.5. Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- CCSS.HSF.LE.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
- CCSS.HSF.LE.4. For exponential models, express as a logarithm the solution to abc = d where a, c, and d are numbers and the base b is 2, 10 or e; evaluate the logarithm using technology
- CCSS.HSF.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

Transfer

Students will be able to independently use their learning to…

- explain the concept of inverse functions through exponential and logarithmic functions
- recognize exponential and logarithmic functions that exist in applications and use their properties to solve the applications

Meaning

ENDURING UNDERSTANDINGS

- Logarithms and exponents have corresponding properties.
- The function $y = e^x$ and $y = \ln x$ are inverse functions.

ESSENTIAL QUESTIONS

- What is the relationship between exponential and logarithmic functions?
- How do exponential and logarithmic functions model real-world problems and their solutions?

Acquisition

Students will understand…

- logarithmic and exponential functions.
- natural base e and the natural ln.
- where logarithmic and exponential functions are found within real-world applications
- the properties of logarithms.

Students will be skilled at…

- graphing logarithmic and exponential functions.
- modeling real world applications functions with exponential and logarithmic expressions.
- identifying a common log and a natural log and determining their base.
- solving expressions and equations where the variable is the exponent.
- making a change of base using the definition of logarithm.
- interpreting results and reflecting on the reasonableness of their solutions and others.

● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others. ● CCSS.MP4 Model with mathematics. ● CCSS.MP5 Use appropriate tools strategically. ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning.		● using technology appropriately to solve mathematical problems. ● recognizing patterns associated with properties of exponents to determine the analogous properties of logarithms.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Precalculus
Unit 4: Trigonometric Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students study trigonometric functions.

Content Standards:

- CCSS.HSF.TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- CCSS.HSF.TF.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
- CCSS.HSF.TF.3. Use special triangles to determine geometrically the values of sine, cosine and tangent for $\pi/3$, $\pi/4$, $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number.
- CCSS.HSF.TF.4. Use the unit circle to explain symmetry and periodicity of trigonometric functions.
- CCSS.HSF.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
- CCSS.HSF.TF.6. Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
- CCSS.HSF.TF.7. Use the inverse functions to solve trigonometric equations.

Transfer

Students will be able to independently use their learning to…

- recognize trigonometric functions that exist in applications and use their properties to solve the applications
- utilize their knowledge of radians as a real measure in their future study of calculus

Meaning

ENDURING UNDERSTANDINGS

- Trigonometry can be used to solve triangles as well as to model waves.

ESSENTIAL QUESTIONS

- How are sine, cosine, and tangent functions related?
- How do you solve real-world applications using trigonometric functions?
- How do you use trigonometric identities to simplify and evaluate expressions?
- How do you use the laws of trigonometry to solve real-world problems?

Acquisition

Students will understand…

- angles and radian measures.
- right triangle trigonometry.
- reference angles.
- trigonometric functions and their graphs.

Students will be skilled at…

- evaluating trigonometric functions of any angle.
- using reference angles to evaluate trigonometric functions.
- sketching graphs of sine, cosine, and tangent and their inverse accurately and precisely.

● CCSS.HSF.TF.8. Prove the Pythagorean identity sin2(X) + cos2(X) = 1 and use it to find sin(X), cos (X), or tan (X) given sin(X), cos(X), or tan(X) and the quadrant of the angle. ○ CCSS.HSF.TF.9. Prove the addition and subtraction formulas for sine cosine, and tangent and use them to solve problems. CCSS.HS.G.SRT.9. Derive the formula (A = ½ absinC) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. ● CCSS.HSG.SRT.10. Prove the Laws of Sines and Cosines and use them to solve problems. ● CCSS.HSG.SRT.11. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles. ● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others. ● CCSS.MP4 Model with mathematics. ● CCSS.MP5 Use appropriate tools strategically. ● CCSS.MP6 Attend to precision. ● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning.	● amplitude, phase shift, and period components of graphs of trigonometric functions ● sum, difference, double angle, and half-angle trigonometric identities. ● the law of Sines and Cosines ● area of a triangle as an application of trigonometry. ● fundamental trigonometric identities	● solving real life problems using right triangle trigonometry. ● verifying trigonometric identities. ● using standard algebraic techniques to solve trigonometric equations. ● using sum, difference, double angle, half-angle formulas to verify and solve trigonometric equations. ● finding the area of an oblique triangle using the law of sine or cosine. ● interpreting results and reflecting on the reasonableness of their solutions and others. ● using technology appropriately to solve mathematical problems. ● recognizing patterns in amplitude, phase shift, and period components of trigonometric functions to generalize a formula for any trigonometric function.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
CP Precalculus
Unit 5: Conic Sections

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students study conic sections and their graphs.

Content Standards:

- CCSS.HSG.GPE.1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
- CCSS.HSG.GPE.2. Derive the equation of a parabola given a focus and directrix.
- CCSS.HSG.GPE.3. Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
- CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.MP4 Model with mathematics.
- CCSS.MP5 Use appropriate tools strategically.
- CCSS.MP6 Attend to precision.
- CCSS.MP7 Look for and make use of structure.

Transfer

Students will be able to independently use their learning to…

- explain how each conic section is related to solids by cross section
- apply their knowledge of conics in solving problems

Meaning

ENDURING UNDERSTANDINGS

- Conic sections can be distinguished by their equations. Not all conics are functions.
- Conics have valid and important applications in the real world including satellite dishes and ultra sonic equipment.

ESSENTIAL QUESTIONS

- How is each conic section related to a cone?
- How are conic sections used to model real-world situations?

Acquisition

Students will understand…

- the general forms of the equation of a circle.
- the general and standard forms of the equation of an ellipse, hyperbola, and parabola
- graphs of circles, hyperbolas, parabolas, and ellipses

Students will be skilled at…

- applying mathematical concepts and computation skills to real world situations.
- algebraically modeling a conic section.
- graphing a conic section from the equation that analytically describes it with accuracy.
- recognizing and solving for the different variables that represent characteristics of a conic section.
- using technology appropriately to solve mathematical problems.
- recognizing structure and patterns associated with graphing circles, ellipses, hyperbolas, and parabolas.

● CCSS.MP8 Look for and express regularity in repeated reasoning.		
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Honors Precalculus

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Relations, Functions, and Graphs	● Characteristics of a function ● Domain and range of a function ● Inverses of functions ● Rigid and nonrigid graphical transformations. ● Higher degree polynomial functions. ● Roots of polynomial equations	● Characteristics within and across families of functions define the shape of a graph and application. ● Relations and functions can be represented numerically, graphically, algebraically and/or verbally.	● Graph higher degree polynomials and other functions ● Graphically manipulate functions and expressions to convey meaning ● Determine zeros, domain, and range polynomial functions ● Find the inverse of a function ● Interpret results and reflect on reasonableness of their solutions and others ● Model problems algebraically, graphically, and with table and charts ● Use technology appropriately to solve mathematical problems. ● Identify functions given tables, equations, or graphs
Unit 2: Rational Expressions and Equations	● Graphs of Rational Functions ● Horizontal, Vertical, and Slant Asymptotes ● Non-Linear and Rational Inequalities	● The zeros and undefined values in the equations of a rational function determine the shape of the graph including holes and asymptotes.	● Graph rational functions by determining domain restrictions, horizontal, vertical, and slant asymptotes, x- and y-intercepts, holes, and other critical points ● Determine solution sets for non-linear and rational inequalities algebraically and graphically ● Interpret results and reflect on reasonableness of their solutions ● Model problems algebraically, graphically, and with table and charts ● Use technology appropriately to solve mathematical problems ● Attend to precision when graphing the key features of a rational function
Unit 3: Exponential and Logarithmic Functions	● Logarithmic and exponential functions and their graphs ● Natural base e and the natural ln ● Real-world applications with common	● Logarithms and exponents have corresponding properties. ● The function $y = e^x$ and $y = \ln x$ are inverse functions.	● Graph logarithmic and exponential functions ● Model real world applications functions with exponential and logarithmic expressions ● Identify a common log and a natural log and determine their base. ● Solve expressions and equations where the variable is the exponent ● Make a change of base using the definition of logarithm. ● Interpret results and reflect on reasonableness of their solutions and others

	logarithmic and exponential functions ● Properties of logarithms		● Use technology appropriately to solve mathematical problems ● Recognize patterns associated with properties of exponents to determine the analogous properties of logarithms
Unit 4: Trigonometric Functions	● Angles and Radian Measure ● Right Triangle Trigonometry ● Reference Angles ● Trigonometric Functions and their graphs ● Amplitude, Phase Shift, Vertical Shift, Period ● Trigonometric Identities ● Laws of Sines and Cosines	● Trigonometry can be used to solve triangles as well as model waves.	● Evaluate trigonometric functions of any angle. ● Use reference angles to evaluate trigonometric functions. ● Sketch graphs of sine, cosine, and tangent graphs and their inverse accurately and precisely. ● Sketch the translations of trigonometric graphs. ● Solve real life problems using right triangle trigonometry. ● Recognize and write fundamental trigonometric equations. ● Verify trigonometric identities. ● Use standard algebraic techniques to solve trigonometric equations. ● Use sum, difference, double angle, half-angle formulas to verify and solve trigonometric equations. ● Find the area of an oblique triangle using the law of sine or cosine. ● Interpret results and reflect on reasonableness of their solutions ● Use technology appropriately to solve mathematical problems
Unit 5: Conics	● Standard and general form of equation and graph of: ● Circle ● Ellipse ● Hyperbola ● Parabola	● Conic sections can be distinguished by their equations. Not all conics are functions. ● Conics have valid and important applications in the real world including satellite dishes and ultrasonic equipment.	● ● Algebraically model a conic section ● Graph a conic section from an equation that analytically describes it with accuracy ● Recognize and solve for the different variables that represent characteristics of a conic section ● Recognize structure and patterns associated with graphing circles, ellipses, hyperbolas, and parabolas
Unit 6: Limits	● Properties of Limits ● Limits of functions and sequences graphically, numerically, and algebraically ● Infinite Limits	● The concept of a limit is one of the foundations of calculus	● Evaluate limits using properties of limits ● Evaluate when a limit can fail to exist ● Evaluate limits at positive and negative infinity ● Interpret results and reflect on reasonableness of their solutions and others ● Use technology appropriately to solve mathematical problems

Windham School District Curriculum
Honors Precalculus
Unit 1: Relations, Functions, & Graphs

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students explore the connections between relations, functions, and their graphs..

Content Standards:

- CCSS.HSA.APR.2. Know and apply the Remainder Theorem.
- CCSS.HSA.APR.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the functions defined by the polynomial.
- CCSS.HSF.IF.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.
- CCSS.HSF.IF.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. CCSS.HSF.IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- CCSS.HSF.IF.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- CCSS.HSF.IF.7. Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases.

Transfer

Students will be able to independently use their learning to…

- describe the similarities and differences of characteristics of various functions
- recognize different functions as they exist in real-world scenarios
- use their knowledge of functions in their future study of calculus

Meaning

ENDURING UNDERSTANDINGS

- Characteristics within and across families of functions define the shape of a graph and application.
- Relations and functions can be represented numerically, graphically, algebraically and/or verbally.

ESSENTIAL QUESTIONS

- What attributes are important for defining and graphing a function or relation?
- How can the properties of functions be used to model and analyze real-world applications and quantitative relationships?

Acquisition

Students will understand…

- the characteristics of a function.
- the domain and range of a function.
- the inverses of relations and functions.
- rigid and non-rigid graphical transformations.

Students will be skilled at…

- graphing higher degree polynomials and other functions.
- graphically manipulating functions and expressions to convey meaning.
- determining zeros, domain, and range of polynomial functions.
- finding the inverse of a function.

● CCSS.HSF.BF.3. Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x+k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. ● CCSS.HSF.FB.4. Find inverse functions. ● CCSS.HSN.NC.8. Extend polynomial identities to the complex numbers. ● CCSS.HSN.NC.9. Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.	● higher degree polynomial functions. ● the roots of polynomial equations.	● interpreting results and reflecting on the reasonableness of their solutions and others. ● modeling problems algebraically, graphically, and with tables and charts. ● using technology appropriately to solve mathematical problems. ● distinguishing between types of functions given tables, equations, or graphs.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Precalculus
Unit 2: Rational Expressions & Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students explore rational functions including their characteristics, equations, and graphs.

Content Standards:

- CCSS.HSA.APR.6. Rewrite simple rational expressions in different forms.
- CCSS.HSA.APR.7. Understand the rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression: add, subtract, multiply, and divide rational expressions.
- CCSS.HSF.IF.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

Transfer

Students will be able to independently use their learning to…

- model rational functions graphically and understand the connection in applications

Meaning

ENDURING UNDERSTANDINGS

- The zeros and undefined values in the equation of a rational function determine the shape of the graph including holes and asymptotes.

ESSENTIAL QUESTIONS

- What is a rational function and how do you graph it?
- How do you identify asymptotes and holes in the graphs of rational functions?
- How do the zeroes and undefined values help to find a solution set for nonlinear or rational inequalities?

Acquisition

Students will understand…

- The graphs of Rational Functions.
- Horizontal, Vertical, and Slant Asymptotes.
- Non-Linear and Rational Inequalities.

Students will be skilled at…

- Graphing rational functions by determining domain restrictions; horizontal, vertical, and slant asymptotes; x and y-intercepts; holes; and other critical points.
- Determining solution sets for non-linear and rational inequalities, algebraically and graphically by looking for general methods and for shortcuts.
- interpreting results and reflecting on the reasonableness of their solutions and others.
- attending to precision when graphing the key features of a rational function.
- modeling problems algebraically, graphically, and with tables and charts.
- using technology appropriately to solve mathematical problems.

Used in Content Area Standards	*21st Century Skills*
not applicable	● collaboration ● critical thinking ● communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Precalculus
Unit 3: Exponential & Logarithmic Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students study the exponential and logarithmic functions including properties and graphs.

Content Standards:

- CCSS.HSA.SSE.2. use the structure of an expression to identify ways to rewrite it.
- CCSS.HSA.SS.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- CCSS.HSF.BF.5. understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- CCSS.HSF.LE1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
- CCSS.HSF.LE.4. For exponential models, express as a logarithm. For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10 or e. Evaluate the logarithm using technology.

Transfer

Students will be able to independently use their learning to…

- explain the concept of inverse functions through exponential and logarithmic functions
- recognize exponential and logarithmic functions that exist in applications and use their properties to solve the applications

Meaning

ENDURING UNDERSTANDINGS

- Logarithms and exponents have corresponding properties.
- The function $y = e^x$ and $y = \ln x$ are inverse functions.

ESSENTIAL QUESTIONS

- What is the relationship between exponential and logarithmic functions?
- How do exponential and logarithmic model real-world problems and their solutions?

Acquisition

Students will understand..

- logarithmic and exponential functions.
- natural base e and natural ln.
- the properties of logarithms.
- real world applications with common logarithmic and exponential functions.

Students will be skilled at…

- graphing logarithmic and exponential functions.
- modeling real world applications functions with exponential and logarithmic expressions.
- identifying a common log and a natural log and determine their base.
- solving expressions and equations where the variable is the exponent.
- making a change of base using the definition of logarithm.
- interpreting results and reflecting on the reasonableness of their solutions and others.

● CCSS.HSF.IF.1. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.		● using technology appropriately to solve mathematical problems. ● recognizing patterns associated with properties of exponents to determine the analogous properties of logarithms.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Precalculus
Unit 4: Trigonometric Functions

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students study trigonometric functions.

Content Standards:

- CCSS.HSF.TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- CCSS.HSF.TF.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
- CCSS.HSF.TF.3. Use special triangles to determine geometrically the values of sine, cosine and tangent for $\pi/3$, $\pi/4$, $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi-x$, $\pi+x$, and $2\pi- x$ in terms of their values for x, where x is any real number.
- CCSS.HSF.TF.4. Use the unit circle to explain symmetry and periodicity of trigonometric functions.
- CCSS.HSF.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
- CCSS.HS.F.TF.6. Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

Transfer

Students will be able to independently use their learning to…

- recognize trigonometric functions that exist in applications and use their properties to solve the applications
- utilize their knowledge of radians as a real measure in their future study of calculus

Meaning

ENDURING UNDERSTANDINGS

- Trigonometry can be used to solve triangles as well as model waves.

ESSENTIAL QUESTIONS

- How are sine, cosine, and tangent functions related?
- How do you solve real-world applications using trigonometric functions?
- How do you use trigonometric identities to simplify and evaluate expressions?
- How do you use the laws of trigonometry to solve real-world problems?

Acquisition

Students will understand…

- angles and radian measure.
- right triangle trigonometry.
- reference angles.
- trigonometric functions and their graphs.
- amplitude, phase shift, vertical shift, and period components of trigonometric functions

Students will be skilled at…

- evaluating trigonometric functions of any angle.
- using reference angles to evaluate trigonometric functions.
- sketching graphs of sine, cosine, and tangent graphs and their inverse.
- sketching the translations of trigonometric graphs.

● CCSS.HSF.TF.7. Use the inverse functions to solve trigonometric equations. ● CCSS.HSF.TF.8. Prove the Pythagorean identity sin2(X) + cos2(X) = 1 and use it to find sin(X), cos (X), or tan (X) given sin(X), cos(X), or tan(X) and the quadrant of the angle. ● CCSS.HSF.TF.9. Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. ● CCSS.HSG.SRT.9. Derive the formula for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. ● CCSS.HSG.SRT.10. Prove the Laws of Sines and Cosines and use them to solve problems. ● CCSS.HSG.SRT.11. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles.	● sum, difference, double angle, and half-angle trigonometric identities. ● the Laws of Sine and Cosine and its use in determining the area of a triangle	● solving real life problems using right triangle trigonometry. ● recognizing and writing fundamental trigonometric equations. ● verifying trigonometric identities. ● using standard algebraic techniques to solve trigonometric equations. ● using sum, difference, double angle, half-angle formulas to verify and solve trigonometric equations. ● finding the area of an oblique triangle using the law of sine or cosine. ● interpreting results and reflecting on the reasonableness of their solutions and others. ● using technology appropriately to solve mathematical problems.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Precalculus
Unit 5: Conic Sections

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a study of Precalculus. In this unit, students study conic sections and their graphs.

Content Standards:

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

Transfer

Students will be able to independently use their learning to…

- explain how each conic section is related to solids by cross section
- apply their knowledge of conics in solving problems

Meaning

ENDURING UNDERSTANDINGS

- Conic sections can be distinguished by their equations. Not all conics are functions.
- Conics have valid and important applications in the real world including satellite dishes and ultrasonic equipment.

ESSENTIAL QUESTIONS

- How is each conic section related to a cone?
- How are conic sections used to model real-world situations?

Acquisition

Students will understand…

- the standard and general forms of the equation of a parabola, circle, ellipse and a hyperbola
- the graphs of parabola, circles, ellipses, and hyperbolas

Students will be skilled at…

- algebraically modeling a conic section.
- graphing a conic section from the equation that analytically describes it with accuracy.
- recognizing and solving for the different variables that represent characteristics of a conic section.
- using technology appropriately to solve mathematical problems.
- recognizing structure and patterns associated with graphing circles, ellipses, hyperbolas, and parabolas.

Used in Content Area Standards

not applicable

21st Century Skills

- Collaboration
- Critical thinking

	• Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Honors Precalculus
Unit 6: Limits

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:
Students will continue their study of mathematics with a study of Precalculus. In this unit, students study trigonometric functions.

Content Standards:
● There are no common core content standards at this level.
● CCSS.MP1 Make sense of problems and persevere in solving them.
● CCSS.MP2 Reason abstractly and quantitatively.
● CCSS.MP3 Construct viable arguments and critique the reasoning of others.
● CCSS.MP5 Use appropriate tools strategically.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● use their knowledge of limits to formally understand the definition of derivative when studying Calculus
● explain the connection between limits and continuity of functions</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● The concept of a limit is one of the foundations of calculus.</td><td>ESSENTIAL QUESTIONS
● What role do limits play in laying the foundation of Calculus?
● How does the limit of a function relate the value approached by f(x) as x approaches a given value or infinity?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● Properties of Limits
● Limits of functions and sequences graphically, numerically, and algebraically
● Infinite Limits</td><td>Students will be skilled at…
● evaluate a limit using properties of limits
● evaluating a limit at positive or negative infinity.
● evaluating when a limit can fail to exist.
● interpreting results and reflecting on the reasonableness of their solutions and others.
● using technology appropriately to solve mathematical problems.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>● Collaboration
● Critical Thinking
● Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Math Modeling

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Creating and Solving Mathematical Models	● The difference between a mathematical model and "word problems" ● The mathematical modeling process. ● Mathematical models in the following areas of study*: ○ Fractals ○ Arts and Music ○ Matrices ○ Architecture ○ Real world data with social implications *thematic units vary each semester based on student interest and available time	● A mathematical model is a representation of a system or scenario that is used to gain qualitative and/or quantitative understanding of some real-world problems and to predict future behavior.	● Define the problem statement ● Make appropriate simplifying assumptions ● Define variables ● distinguish between independent variables, dependent variables, and model parameters ● Get a solution ● Apply appropriate technology ● Analyze and assess their model and make revisions as is necessary and time permits ● Report results in written, visual, and/or verbal from. ● Generalize their model solution to model similar situations

Windham School District Curriculum
Math Modeling (Semester)
Creating & Solving Mathematical Models

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more exploration of Mathematical Models. In this course, students will learn how to define problems and use modeling to develop a solution then report results. Models will be explored, based on time and interest, in the following areas: Fractals, Arts and Music, Matrices, Architecture, and Real world data with social implications.

Content Standards:

- No specific common core content standards exist.
- CCSS.MP1 Make sense of problems and persevere in solving them
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP3 Construct viable arguments and critique the reasoning of others
- CCSS.MP4 Model with mathematics
- CCSS.MP5 Use appropriate tools strategically
- CCSS.MP6 Attend to precision.
- CCSS.MP7 Look for and make use of structure
- CCSS.MP8 Look for and express regularity in repeated reasoning

Transfer

Students will be able to independently use their learning to…

- apply their knowledge of mathematical modeling to solve problems in areas of personal interest or future professional pursuits.

Meaning

ENDURING UNDERSTANDINGS

- A mathematical model is a representation of a system or scenario that is used to gain qualitative and/or quantitative understanding of some real-world problems and to predict future behavior.

ESSENTIAL QUESTIONS

- How do we use our mathematical toolkit to develop a useful mathematical model?

Acquisition

Students will understand…

- The difference between a mathematical model and “word problems”
- The mathematical modeling process.
- Mathematical models in the following areas of study*:
  - Fractals
  - Arts and Music
  - Matrices
  - Architecture
  - Real world data with social implications

*thematic units vary each semester based on student interest and available time

Students will be skilled at…

- Defining the problem statement
- Making appropriate simplifying assumptions
- Defining variables
- distinguishing between independent variables, dependent variables, and model parameters
- Getting a solution
- Applying appropriate technology
- Analyzing and assessing their model and make revisions as is necessary and time permits
- Reporting results in written, visual, and/or verbal from.
- Generalizing their model solution to model similar situations

Used in Content Area Standards	*21st Century Skills*
	● Critical Thinking ● Perseverance ● Collaboration ● Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Projects or Written Assignments
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Trigonometry (Semester)

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Triangular Trigonometry	● Degree, Minute, Second (DMS) ● Right Triangle Trigonometry ● Sine ● Cosine ● Tangent ● Law of Sines ● Law of Cosines ● Ambiguous Case ● Angle of Elevation ● Angle of Depression ● Bearing	● There are various real-life applications where the use of the Pythagorean Theorem along with trigonometric ratios can help us solve for missing information. ● Trigonometric functions are derived from ratios of the sides of right triangles in relation to a given acute angle.	● Use a calculator to find trigonometric values of a given angle in both degree mode and DMS mode. ● Use a calculator to find an angle, in both degree and DMS mode, given trigonometric value. ● Define trigonometric functions (sine, cosine, tangent) using right triangles ● Solve triangles using the law of sines including the ambiguous case. ● Solve triangles using the law of cosines. ● Solve real life problems using right triangle trigonometry and Laws of Sines and Cosines.
Unit 2: Circular Trigonometry	● Angles in Degree Measure, Radian Measure, and Rotation Measure ● Reference Angles ● Coterminal Angles ● Standard position angles ● Special Right Triangles to understand exact values of trigonometric functions of special angles ● 6 trigonometric functions: sine, cosine, tangent, secant, cosecant, cotangent ● Unit circle ● Trigonometric equations ● Basic trigonometric identities: pythagorean identity, quotient identity	● An angle with a full circle rotation measures 2π radians. An angle with a semicircle rotation measures π radians. ● The characteristics of trigonometric and circular functions and their representations are useful in solving real-world problems.	● Develop and replicate the unit circle ● Evaluate trigonometric functions of any angle using either the unit circle or special right triangles. ● Use reference angles to evaluate trigonometric functions. ● Sketch graphs of sine, cosine, and tangent graphs and their respective inverses accurately and precisely. ● Solve basic trigonometric equations. ● Verify basic trigonometric identities.

Unit 3: Trigonometric Functions and Modeling	● Trigonometric Functions and their graphs ● Amplitude, Period, Phase Shift, and Vertical Shift	● The characteristics of trigonometric and circular functions and their representations are useful in solving real-world problems.	● Sketching graphs of sine, cosine, and tangent graphs accurately and precisely.. ● Use technology appropriately to solve mathematical problems ● Recognize patterns in amplitude, phase shift, and period components of trigonometric functions to generalize a formula for any trigonometric function ● Explore models of trigonometric functions

Windham School District Curriculum
Trigonometry (Semester)
Unit 1: Triangular Trigonometry

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a semester study in Trigonometry. In this unit, students solve triangles using both right triangular trigonometry and the laws of sines and cosines. An emphasis will be placed on applications of triangular trigonometry.

Content Standards:

- CCSS.HSG.SRT.10. Prove the Laws of Sines and Cosines and use them to solve problems.
- CCSS.HSG.SRT.11. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles.
- CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP4 Model with mathematics.
- CCSS.MP5 Use appropriate tools strategically.
- CCSS.MP6 Attend to precision.

Transfer

Students will be able to independently use their learning to…

- recognize trigonometric functions that exist in applications and use their properties to solve the applications

Meaning

ENDURING UNDERSTANDINGS

- There are various real-life applications where the use of the Pythagorean Theorem along with trigonometric ratios can help us solve for missing information.
- Trigonometric functions are derived from ratios of the sides of right triangles in relation to a given acute angle.

ESSENTIAL QUESTIONS

- When and why are there sometimes two solutions when solving for sides and angles of triangles?
- When do I need to use the law of sines and cosines to solve real-life problems?
- How can your calculator fool you into thinking a wrong answer is correct?

Acquisition

Students will understand…

- Degree, Minute, Second (DMS)
- Right Triangle Trigonometry
- Sine
- Cosine
- Tangent
- Law of Sines
- Law of Cosines
- Ambiguous Case
- Angle of Elevation
- Angle of Depression

Students will be skilled at…

- Using a calculator to find trigonometric values of a given angle in both degree mode and DMS mode.
- Using a calculator to find an angle, in both degree and DMS mode, given trigonometric value.
- Defining trigonometric functions (sine, cosine, tangent) using right triangles
- Solving triangles using the law of sines including the ambiguous case.

	● Bearing	● Solving triangles using the law of cosines. ● Solving real life problems using right triangle trigonometry and Laws of Sines and Cosines.
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Trigonometry (Semester)
Unit 2: Circular Trigonometry

Stage 1 Desired Results

ESTABLISHED GOALS:

Students will continue their advanced study of mathematics with a semester study in Trigonometry. In this unit, students explore the unit circle and use it to find exact trigonometric values. They will also solve trigonometric equations and recognize basic trigonometric identities.

Content Standards:

- CCSS.HSF.TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- CCSS.HSF.TF.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
- CCSS.HSF.TF.3. Use special triangles to determine geometrically the values of sine, cosine and tangent for
- π/3, π/4, π/6, and use the unit circle to express the values of sine, cosine, and tangent for π-x, π+x, and 2π - x in terms of their values for x, where x is any real number.
- CCSS.HSF.TF.4. Use the unit circle to explain symmetry and periodicity of trigonometric functions.
- CCSS.HSF.TF.7. Use the inverse functions to solve trigonometric equations.
- CCSS.HSF.TF.8. Prove the Pythagorean identity sin2(X) + cos2(X) = 1 and use it to find sin(X), cos (X), or tan (X) given sin(X), cos(X), or tan(X) and the quadrant of the angle.

Transfer

Students will be able to independently use their learning to…

- understand how the unit circle is created and use it when finding trigonometric values.
- use basic identities to establish other identities

Meaning

ENDURING UNDERSTANDINGS

- An angle with a full circle rotation measures 2π radians. An angle with a semicircle rotation measures π radians.
- The characteristics of trigonometric and circular functions and their representations are useful in solving real-world problems.

ESSENTIAL QUESTIONS

- What is the fundamental difference between a degree and a radian?
- How can the unit circle help us evaluate trig functions quickly?
- How are the circular functions related to the trigonometric functions?

Acquisition

Students will understand…

- Angles in Degree Measure, Radian Measure, and Rotation Measure
- Reference Angles
- Coterminal Angles
- Standard position angles
- Special Right Triangles to understand exact values of trigonometric functions of special angles

Students will be skilled at…

- Developing and replicating the unit circle
- Evaluating trigonometric functions of any angle using either the unit circle or special right triangles.
- Using reference angles to evaluate trigonometric functions..
- Solve basic trigonometric equations.
- Verify basic trigonometric identities.

● CCSS.MP1 Make sense of problems and persevere in solving them. ● CCSS.MP2 Reason abstractly and quantitatively. ● CCSS.MP3 Construct viable arguments and critique the reasoning of others. ● CCSS.MP7 Look for and make use of structure. ● CCSS.MP8 Look for and express regularity in repeated reasoning.	● 6 trigonometric functions: sine, cosine, tangent, secant, cosecant, cotangent ● Unit circle ● Trigonometric equations ● Basic trigonometric identities: pythagorean identity, quotient identity	
Used in Content Area Standards		***21st Century Skills***
		● Critical Thinking ● Communication ● Collaboration ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Trigonometry (Semester)
Unit 3: Trigonometric Functions & Modeling

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their advanced study of mathematics with a semester study in Trigonometry. In this unit, students explore the graphs of the trigonometric functions and apply models of these functions to real life applications.

Content Standards:

- CCSS.HSF.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
- CCSS.HSF.TF.6. Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
- CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP4 Model with mathematics.
- CCSS.MP5 Use appropriate tools strategically.
- CCSS.MP6 Attend to precision.
- CCSS.MP7 Look for and make use of structure.

Transfer

Students will be able to independently use their learning to…

- recognize the graphs of trigonometric functions in real-life applications and use the different aspects of the graphs to determine what is happening in the applications.

Meaning

ENDURING UNDERSTANDINGS

- The characteristics of trigonometric and circular functions and their representations are useful in solving real-world problems.

ESSENTIAL QUESTIONS

- How do trigonometric functions model real world problems and their solutions?
- How are the circular functions related to the graphs of the trigonometric functions?
- How do you use sine and cosine functions to model real-life data?

Acquisition

Students will understand…

- Trigonometric Functions and their graphs
- Amplitude, Period, Phase Shift, and Vertical Shift

Students will be skilled at…

- Sketching graphs of sine, cosine, and tangent graphs accurately and precisely..
- Use technology appropriately to solve mathematical problems
- Recognize patterns in amplitude, phase shift, and period components of trigonometric functions to generalize a formula for any trigonometric function
- Explore models of trigonometric functions

Used in Content Area Standards	*21st Century Skills*
	• Critical Thinking • Communication • Collaboration • Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: Statistics (semester)

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Descriptive Statistics	● Graphical Displays ● Types of data collection ● Bias ● Summary Statistics ● Descriptions ● Comparisons ● Correlation	● Data can be collected, displayed, described, and summarized in response to a question that has been raised. ● Proper techniques of experimentation and sampling can decrease or eliminate bias and confounding variables.	● Create and interpret graphical displays of data ● Describe data ● Identify situations as experiments or studies ● Develop and critique surveys ● Describe the types of bias that may exist.
Unit 2: Statistical Analysis	● Normal Models ● Percentages and percentiles ● Standard Deviation ● Z-scores ● Central Limit Theorem ● Confidence Intervals	● To best describe a set of data, both measures of center and measures of dispersion need to be understood	● Calculate summary statistics ● Compare distributions ● Draw conclusions about individuals based on the normal model. ● Summarize data sets using multiple statistical viewpoints
Unit 3: Probability	● Rules of probability ● Expected Value ● Simulations	● Probability of random events can be calculated with rules or estimated with simulation	● Calculate probabilities of different events ● Calculate expected value and make observations ● Simulate a situation and compare it to a theoretical probability

Windham School District Curriculum
Statistics(Semester)
Unit 1: Descriptive Statistics

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a brief semester study of Statistics and Probability. In this unit, students will learn how to describe and represent data in multiple formats.

Content Standards:

- CCSS.HSS.ID.A Summarize, represent and interpret data on a single count or measurement variable. Summarize, represent, and interpret data on two categorical and quantitative variables.
- CCSS.HSS.ID.B Interpret linear models.
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP4 Model with mathematics.

Transfer

Students will be able to independently use their learning to…

- differentiate between biased and unbiased data given in newspapers, magazines and other news sources.
- use their introductory knowledge of data collection in future statistical courses as well as applying it in future careers.

Meaning

ENDURING UNDERSTANDINGS

- Data can be collected, displayed, described, and summarized in response to a question that has been raised.
- Proper techniques of experimentation and sampling can decrease or eliminate bias and confounding variables.

ESSENTIAL QUESTIONS

- How is data used in the real world?
- When is data normal?

Acquisition

Students will understand…

- graphical displays for categorical and quantitative data.
- planning and conducting various types of data collection.
- forms of Bias
- Generalization of results with summary statistics.
- Descriptive features of a distribution.
- correlations

Students will be skilled at…

- creating and interpreting graphical displays of data
- describing distributions of univariate data.
- making comparisons with data sets.
- identifying situations as experiments or studies
- developing and critiquing surveys
- explaining the scope of the results of a survey or experiment.
- recognizing bias in data collection.

		● planning surveys and experiments to reduce or eliminate bias.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Statistics(Semester)
Unit 2: Statistical Analysis

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with a brief semester study of Statistics and Probability. In this unit, students will learn how to analyze and summarize data using both measures of center and measures of dispersion.

Content Standards:
● CCSS.HSS.IC.B.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies, explain how randomization relates to each.
● CCSS.HSS.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● be a conscientious citizen with the ability to analyze real life date and therefore make best choices</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● To best describe a set of data, both measures of center and measures of dispersion need to be understood</td><td>ESSENTIAL QUESTIONS
● What are good ways of collecting data?
● Why is randomization / random sampling important?
● What is the difference between an experiment and an observational study?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● normal models
● mean and the standard deviation.
● Z-scores.
● Central Limit Theorem.
● Confidence intervals
● Measures of center: mean, median, mode
● Measures of dispersion</td><td>Students will be skilled at…
● Analyzing data using mean and standard deviation
● summarizing the center and spread of univariate data.
● writing comparisons of distributions of univariate data.
● using z-scores to draw conclusions about individuals based on the normal model.
● summarizing and explaining the scope of the results of survey or experimental data using multiple statistical viewpoints.
● calculating and applying percentages and percentiles.
● finding and using confidence intervals to analyze data.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>● Critical Thinking
● Communication
● Technology Literacy</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
Statistics(Semester)
Unit 3: Probability

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a brief semester study of Statistics and Probability. In this unit, students will learn different techniques for finding experimental and theoretical probabilities as well as how to use probabilities to predict the future.

Content Standards:

- CCSS.HSS.IC.A.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
- CSSC.HSS.CP.A Understand independence and conditional probability and use them to interpret data.
- CCSS.HSS.CP.B Use the rules of probability to compute probabilities of compound events in a uniform probability model.
- CCSS.HSS.MD.A Calculate expected values and use them to solve problems.
- CCSS.HSS.MD.B Use probability to evaluate outcomes of decisions.
- CCSS.MP1 Make sense of problems and persevere in solving them.
- CCSS.MP5 Use appropriate tools strategically.
- CCSS.MP7 Look for and make use of structure.
- CCSS.MP8 Look for and express regularity in repeated reasoning.

Transfer

Students will be able to independently use their learning to…

- use their ability to find the probability of an event to predict the end result of an outcome

Meaning

ENDURING UNDERSTANDINGS

- Probability of random events can be calculated with rules or estimated with simulation

ESSENTIAL QUESTIONS

- Why is it important to understand the likelihood of an event?
- How do you calculate theoretical probability?
- How can you simulate a situation?

Acquisition

Students will understand…

- The likelihood of an event occurring
- rules of probability
- simulation.
- expected Value.

Students will be skilled at…

- calculating various probabilities using the laws of probability.
- conducting a simulation to estimate a probability or expected value.
- simulating a situation and comparing the results to a theoretical probability

Used in Content Area Standards

not applicable

21st Century Skills

- Critical Thinking
- Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Title of Curriculum: AP Statistics

Unit Name	What (content, vocab)	Why (enduring understandings)	How (skills)
Unit 1: Descriptive Statistics	● Graphical Displays for categorical and quantitative data ● Summary Statistics ● Description of distributions ● Normal Models and z-scores ● Regression Lines	● Data can be collected, displayed, described, and summarized in response to a question that has been raised.	● Create and interpret graphical displays of data ● Identify types of data ● Summarize center and spread ● Compare distributions ● Make calculations about individuals based on the normal model ● Calculate a regression line for bivariate data ● Interpret and make predictions based on the regression line
Unit 2: Inferential Statistics	● Sampling Distributions ● Normal, T and Chi-Square distributions ● Central Limit Theorem ● Hypothesis tests ● Confidence Intervals ● Statistical Significance ● Types of Errors	● You can infer something about the population by taking a sample. ● You can decide the significance of a statistic.	● Calculate probabilities about samples ● Calculate and interpret Confidence Intervals ● Do and interpret Hypothesis Tests ● Choose appropriate type of inference ● Explain what type of errors exist and their consequences
Unit 3: Experimental Design	● Surveys ● Observational Studies ● Experiments ● Simulations ● Bias ● Types of data collection	● Proper techniques of experimentation and sampling can decrease or eliminate bias and confounding variables.	● Use techniques of randomization in surveys, studies, and experiments ● Develop and critique surveys ● Identify situations as experiments, surveys, or studies ● Design and run simulations ● Describe the types of bias, confounding or lurking variables that may exist.
Unit 4: Probability	● Rules of probability ● Expected Value ● Tests of independence	● Probabilities of random events can be calculated with rules or estimated with simulation.	● Calculate probabilities of different events ● Calculate expected value and make

	● Sum and difference of random variables ● Simulations		decisions based on that ● Calculate the mean and standard deviation of a sum or difference of two random variables ● Decide whether two variables are independent or not ● Simulate a situation and compare it to a theoretical probability

Windham School District Curriculum
AP Statistics
Unit 1: Descriptive Statistics

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more deep exploration of Statistics and Probability. In this unit, students describe a set of data using both verbal and graphical approaches.

Content Standards:

- CCSS.HSS-ID Summarize, represent, and interpret data on a single count or measurement variable. Summarize, represent, and interpret data on two categorical and quantitative variables.
- CCSS.HSS.IC.6. Evaluate reports based on data.
- CCSS.MP2 Reason abstractly and quantitatively.
- CCSS.MP4 Model with mathematics.

Transfer

Students will be able to independently use their learning to…

- use their knowledge of statistics to analyze and summarize data related to their life
- apply their data analysis tools to data found in their future career pursuits

Meaning

ENDURING UNDERSTANDINGS

- Data can be collected, displayed, described, and summarized in response to a question that has been raised.

ESSENTIAL QUESTIONS

- How is data used in the real world?
- When is data normal?

Acquisition

Students will understand…

- graphical displays for categorical and quantitative data.
- descriptive features of a distribution.
- Summary Statistics.
- normal distributions and z-scores.
- least squares regression line.

Students will be skilled at…

- identifying types of data.
- creating and interpreting graphical displays of data.
- summarizing center and spread of univariate data.
- writing comparisons of distributions of univariate data.
- making calculations about individuals based on the normal model
- making predictions using the least squares regression line.
- linearizing data with transformations.

Used in Content Area Standards

not applicable

21st Century Skills

- Critical Thinking
- Communication

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Statistics
Unit 2: Inferential Statistics

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more deep exploration of Statistics and Probability. In this unit, students will expand their statistical knowledge by learning to infer facts from the given data.

Content Standards:
● There are no common core standards for this unit.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● be a conscientious citizen with the ability to make key inferences based on real life data and therefore make best choices</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● You can infer something about the population by taking a sample.
● You can decide the significance of a statistic.</td><td>ESSENTIAL QUESTIONS
● What is a sampling distribution?
● What is the importance of a hypothesis test?
● What is the importance of a confidence interval?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● sampling distributions.
● Central Limit Theorem.
● different distributions are used for different types of inference (normal, t, chi-square).
● hypothesis tests.
● Confidence Intervals.
● types of errors.
● statistical significance</td><td>Students will be skilled at…
● calculating probabilities about samples
● describing different sampling distributions.
● sampling distributions to find the likelihood of getting a certain statistic.
● calculating test statistics, p-values and draw conclusions in hypothesis tests.
● constructing confidence intervals and interpret them in context.
● choosing appropriate type of inferences
● explaining the types of errors</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>● Critical Thinking
● Communication</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Statistics
Unit 3: Experimental Design

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will continue their study of mathematics with a more deep exploration of Statistics and Probability. In this unit, students will explore best practices for designing experiments as well as develop their own experiment or survey.

Content Standards:
● CCSS.HSS.IC.B.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies, explain how randomization relates to each.
● CCSS.HSS.IC.B.5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
● CCSS.MP 5 Use appropriate tools strategically.
● CCSS.MP 7 Look for and make use of structure.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● design an unbiased experiment or survey and then create a report of their findings</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Proper techniques of experimentation and sampling can decrease or eliminate bias and confounding variables.</td><td>ESSENTIAL QUESTIONS
● What are good ways of collecting data?
● Why is randomization/random sampling important?
● What is the difference between an experiment and an observational study?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will understand…
● type of bias
● types of data collection.
● requirements needed when planning and conducting surveys.
● requirements needed when planning and conducting experiments.
● generalization of results.
● usefulness of simulating an event.
● observational studies</td><td>Students will be skilled at…
● explaining whether a situation is an experiment, survey or observational study.
● incorporating randomness into surveys, studies and experiments.
● planning and critiquing surveys
● describing the types of bias, confounding or lurking variables that may exist
● planning and running a simulation.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● Critical Thinking ● Communication

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: Written Assessments or Projects
	OTHER EVIDENCE: independent practice, classroom observations and discussions

Windham School District Curriculum
AP Statistics
Unit 4: Probability

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will continue their study of mathematics with a more deep exploration of Statistics and Probability. In this unit, students develop a deeper knowledge of techniques for finding probabilities.

Content Standards:

- CCSS.HSS.IC.A.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
- CCSS.HSS.CP Understand independence and conditional probability and use them to interpret data.Use the rules of probability to compute probabilities of compound events in a uniform probability model.
- CCSS.HSS.MD Calculate expected values and use them to solve problems. Use probability to evaluate outcomes of decisions.
- CCSS.MP 1 Make sense of problems and persevere in solving them.
- CCSS.MP 5 Use appropriate tools strategically.
- CCSS.MP 7 Look for and make use of structure.
- CCSS.MP 8 Look for and express regularity in repeated reasoning.

Transfer

Students will be able to independently use their learning to…

- Use their knowledge of probability and change when making real life decisions

Meaning

ENDURING UNDERSTANDINGS

- Probabilities of random events can be calculated with rules or estimated with simulation.

ESSENTIAL QUESTIONS

- Why is it important to understand the likelihood of an event?
- How do you calculate theoretical probability?
- How can you simulate a situation?
- What value can you expect to have over the long term if an experiment is repeated many times?

Acquisition

Students will understand…

- the likelihood of an event occurring using laws of probability and simulation.
- expected Value.
- criteria for variables being independent or not

Students will be skilled at…

- calculating various probabilities using the laws of probability.
- calculating expected values and make decisions
- calculating mean and standard deviation of sum and difference of two random variables
- testing for independence

	● sum and difference of random variables	● simulate a situation and compare to a probability
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical Thinking ● Communication

Stage 2 - Evidence		
Evaluative Criteria	***Assessment Evidence***	
	ASSESSMENT: Written Assessments or Projects	
	OTHER EVIDENCE: independent practice, classroom observations and discussions	

ADDENDUM: MASTERY TOPICS - MATHEMATICS - GRADES 9 to 12

note: All curriculum topics will be discussed. The topics listed below will be emphasized, revisited, and assessed multiple times.

Algebra 1:

- Solve multistep equations (including with fractions) with applications and explanations
- Solve absolute value equations
- Graph functions using input/output tables
- Solve proportions
- Solve percent problems
- Solve and graph one-variable inequalities including multi-step, fractional, and compound inequalities
- Find the slope of a line using the formula, given an equation or graph
- Graph linear equations in slope-intercept form and standard form
- Graph linear inequalities in 2 variables on a coordinate plane
- Write equations in slope-intercept and point-slope form
- Solve system of linear equations using graphing, substitution and linear combinations
- Solve systems of linear inequalities by graphing.
- Understand a function: what is it?; basic notation; evaluate functions
- Add, subtract, multiply polynomials
- Using lines of best fit to answer questions (such as starting point as y-intercept; describing what the slope means; finding values at a particular point including beyond what the graph shows you

CP Algebra 1:

- Solve multistep equations (including with fractions) with applications and explanations
- Solve absolute value equations
- Graph functions using input/output tables
- Solve proportions
- Solve percent problems
- Solve and graph one-variable inequalities including multi-step, fractional, and compound inequalities
- Find the slope of a line using the formula, given an equation or graph
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- Graph linear inequalities in 2 variables on a coordinate plane
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- Solve systems of linear inequalities by graphing.
- Understand a function: what is it?; basic notation; evaluate functions
- Add, subtract, multiply polynomials

- Using lines of best fit to answer questions (such as starting point as y-intercept; describing what the slope means; finding values at a particular point including beyond what the graph shows you

Geometry:

- On a coordinate plane, find the distance between 2 points, the length of a segment, and the midpoint of a segment. Also apply the segment addition postulate.
- Use all angle relationships including: pairs of angles formed by parallel lines; complementary and supplementary angles; linear pair; and vertical angles.
- Apply the angle addition postulate.
- Understand the characteristics of parallel and perpendicular lines
- Solve problems using similarity of triangles and other polygons (including ratio of areas) and solids (including ratio of volumes) and dilations.
- Justify one's reasoning, throughout the school year, by use of informal proofs, justifications, logical reasoning and proof of evidence.
- Using different units of measure and converting in one, two and three dimensions.
- Know and use all facts of triangles and quadrilaterals.
- Apply the pythagorean theorem to solve problems.
- Know and use the facts of right triangles (special rights & trigonometry) to solve triangles and their applications.
- Know and use facts of circles
- Solve problems using congruence (triangles and other polygons)
- Apply prior knowledge 2-D (area to solve applications) & 3D (surface area of prisms and pyramids and volumes for all solids) shapes to solve applications (note: On surface area, emphasize breaking the shape into its parts rather than using the formula).

CP Geometry:

- On a coordinate plane, find the distance between 2 points, the length of a segment, and the midpoint of a segment. Also apply the segment addition postulate.
- Use all angle relationships including: pairs of angles formed by parallel lines; complementary and supplementary angles; linear pair; and vertical angles.
- Apply the angle addition postulate.
- Understand the characteristics of parallel and perpendicular lines
- Solve problems using similarity of triangles and other polygons (including ratio of areas) and solids (including ratio of volumes) and dilations.
- Justify one's reasoning, throughout the school year, by use of informal proofs, justifications, logical reasoning and proof of evidence.
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- Know and use facts of circles
- Solve problems using congruence (triangles and other polygons)
- Apply prior knowledge 2-D (area to solve applications) & 3D (surface area of prisms and pyramids and volumes for all solids) shapes to solve

applications (note: On surface area, emphasize breaking the shape into its parts rather than using the formula).

Honors Geometry:

- On a coordinate plane, find the distance between 2 points, the length of a segment, and the midpoint of a segment. Also apply the segment addition postulate.
- Use all angle relationships including: pairs of angles formed by parallel lines; complementary and supplementary angles; linear pair; and vertical angles.
- Apply the angle addition postulate.
- Understand the characteristics of parallel and perpendicular lines
- Solve problems using similarity of triangles and other polygons (including ratio of areas) and solids (including ratio of volumes) and dilations.
- Justify one's reasoning, throughout the school year, by use of informal proofs, justifications, logical reasoning and proof of evidence.
- Using different units of measure and converting in one, two and three dimensions.
- Know and use all facts of triangles and quadrilaterals.
- Apply the pythagorean theorem to solve problems.
- Know and use the facts of right triangles (special rights & trigonometry) to solve triangles and their applications.
- Know and use facts of circles
- Solve problems using congruence (triangles and other polygons)
- Apply prior knowledge 2-D (area to solve applications) & 3D (surface area of prisms and pyramids and volumes for all solids) shapes to solve applications (note: On surface area, emphasize breaking the shape into its parts rather than using the formula).
- Use the Law of sines and cosines to solve problems

Algebra 2 Part A:

- Solve compound inequalities and applications
- Solve absolute value equations
- Graph absolute value equations and inequalities using a table of values and using basic transformations. Find domain and range.
- Graph quadratics using a table of values and basic transformations
- Find domain and range of quadratic functions
- Find vertex, zeros, y-intercept, direction of opening, and axis of symmetry of quadratic functions.
- Understand the difference between vertex and standard form of quadratic functions
- Solve application problems for quadratic functions
- Factor polynomials using greatest common factor, difference of squares, and trinomials to find zeros
- Graph systems of linear inequalities
- Use function notation for evaluating and graphing functions.

CP Algebra 2:

- Factoring (trinomials with coefficient = 1; trinomials with coefficient not = 1; difference of squares; GCF; grouping;)

- Division of polynomials
- Graph Quadratic functions including basic transformations in both vertex form and standard form
- Find domain and range of functions
- Analyze quadratic functions (given graph or equation) for max, min, zeros, y-intercept, direction of opening, axis of symmetry
- Solve quadratic equations by factoring and using the quadratic formula
- Graph absolute value equations with transformations
- Evaluate and analyze functions given their graph
- Solving systems of a quadratic function and a linear function graphically and algebraically
- Composition of functions
- Operations with complex numbers
- Simplify expressions with integer and rational exponents
- Simplify numeric and algebraic radical expressions (to 3rd degree)

Honors Algebra 2:

- Factoring (trinomials with coefficient = 1; trinomials with coefficient not = 1; difference of squares; GCF; grouping;)
- Division of polynomials
- Graph Quadratic functions including basic transformations in both vertex form and standard form
- Find domain and range of quadratic functions
- Analyze quadratic functions (given graph or equation) for max, min, zeros, y-intercept, direction of opening, axis of symmetry
- Solve quadratic equations by factoring, completing the square, and using the quadratic formula
- Graph absolute value equations with transformations
- Evaluate and analyze functions given their graph
- Composition of functions
- Solving systems of a quadratic function and a linear function graphically and algebraically
- Operations with complex numbers
- Simplify expressions with integer and rational exponents
- Solve equations with integer and rational exponents
- Simplify numeric and algebraic radical expressions
- Solve radical equations
- Solve exponential functions (2^x = 8)
- Perform operations with rational expressions

Precalculus:

- Trigonometry (unit circle, evaluate, applications, laws, graphs)
- Exponential/logarithmic functions (properties, solving, graphs, applications)
- Higher degree polynomials (graphs, transformations, analyze, properties)
- Inverse Functions

● Rational functions (properties, graphs, applications, analyze)
Precalculus: ● Trigonometry (unit circle, evaluate, applications, laws, graphs) ● Exponential/logarithmic functions (properties, solving, graphs, applications) ● Higher degree polynomials (graphs, transformations, analyze, properties) ● Inverse Functions ● Rational functions (properties, graphs, applications, analyze) ● Trigonometry (Identities, Formulas) ● Conics (graph, properties, analyze) ● Limits