

Algebra II

This Algebra II course offers students the opportunity to expand and deepen the topics from Algebra I, to introduce advanced algebraic topics and to increase problem-solving skills. It requires students to recognize more sophisticated patterns and discover those algebraic relations that can be used to symbolically represent those patterns. They should be able to should recognize, describe, and generalize patterns and build mathematical models to describe, interpret, and predict the behavior of real-world phenomenon. Students are introduced to a variety of algebraic relations as a gateway to greater understanding of Algebra as a basic tool of higher level mathematics, science, economics and engineering.

Content Strand: Functions and Algebra

Process Strands: Problem solving, Reasoning and Proof, Communications, Connections, and Representations

Major Concepts:

Algebra Vocabulary and Symbols

Real and Complex numbers
Equations
Variables
Algebraic Expressions
Algebraic Properties

Patterns
Relations
Functions
Powers

Patterns, Relations and Functions

Slope, Rate of Change
Modeling
Graphing
Piecewise
Systems of Equations
Composite Functions
Inverse Relations

Linear
Quadratic
Exponential
Logarithmic
Polynomial
Rational

Equivalence

Equations
Inequalities
Absolute Value
Exponents
Logarithms
Radicals

Matrices
Linear Systems
Quadratic Systems
Conic Sections

Major Stems:

1. Identifies and extends to specific cases a variety of linear and nonlinear patterns.
2. Demonstrates conceptual understanding of linear and nonlinear functions and relations.
3. Demonstrates conceptual understanding of algebraic expressions.
4. Demonstrates conceptual understanding of equality.

Algebra II Course Content Competencies:

1. Students will understand and compare the properties of classes of functions and perform operations and transformations on them.
2. Students will understand that a variety of patterns, relations, and functions can be used to describe, interpret, represent, and predict real world phenomena.
3. Students will understand how to use tables, graphs, and equations are ways for depicting and analyzing patterns of change in various types of data sets.
4. Students will understand how to manipulate symbolic statements by mathematical rules to produce equivalent statements and the necessity, importance, and application thereof.

Algebra II Course Process Skills:

1. Students will understand that a variety of problem-solving strategies can be used to investigate even/day as well as increasingly complex mathematical situations.
2. Students will understand that exploring, justifying, and synthesizing mathematical conjectures are part of systemic reasoning which is common to all content areas and a defining feature of mathematics.
3. Students will understand that actively exploring, investigating, describing, and explaining mathematical ideas promotes communication which leads to a greater comprehension of mathematical concepts.
4. Students will understand that mathematical connections will help them become aware of the usefulness of mathematics, serve to bridge the concrete and the abstract, and enable deeper understanding of important ideas.
5. Students will understand that representing ideas and connecting the representations lies at the heart of understanding mathematics.

Functions and Algebra Strand – Stem 1	
Identifies and extends to specific cases a variety of linear and nonlinear patterns	
Topics	Arithmetic and geometric sequences; linear and nonlinear patterns; variables, expressions and equivalent expressions
Competencies	<ol style="list-style-type: none"> 1. Students will understand and compare the properties of classes of functions and perform operations and transformations on them. 2. Students will understand that a variety of patterns, relations, and functions can be used to describe, interpret, represent, and predict real world phenomena. 3. Students will understand how to use tables, graphs, and equations are ways for depicting and analyzing patterns of change in various types of data sets. 4. Students will understand how to manipulate symbolic statements by mathematical rules to produce equivalent statements and the necessity, importance, and application thereof.
Knowledge/Skills	<ol style="list-style-type: none"> 1. Identifies, extends, and generalizes a variety of patterns (polynomial, exponential, logarithmic, rational) represented by models, tables, sequences, or graphs in problem solving situations. 2. Generalizes linear and non-linear relationships (using technology when appropriate). 3. Identifies arithmetic and geometric sequences to the nth term then uses the generalization to find a specific term.
Process Skills	<ol style="list-style-type: none"> 1. Students will understand that a variety of problem-solving strategies can be used to investigate everyday as well as increasingly complex mathematical situations. 2. Students will understand that exploring, justifying, and synthesizing mathematical conjectures are part of systemic reasoning which is common to all content areas and a defining feature of mathematics. 3. Students will understand that actively exploring, investigating, describing, and explaining mathematical ideas promotes communication which leads to a greater comprehension of mathematical concepts. 4. Students will understand that mathematical connections will help them become aware of the usefulness of mathematics, serve to bridge the concrete and the abstract, and enable deeper understanding of important ideas. 5. Students will understand that representing ideas and connecting the representations lies at the heart of understanding mathematics.

Functions and Algebra Strand – Stem 2	
Demonstrates conceptual understanding of linear and nonlinear functions and relations.	
Topics	Classes of functions; rates of change; representations of functions and relations; variable relationships
Competencies	<ol style="list-style-type: none"> 1. Students will understand and compare the properties of classes of functions and perform operations and transformations on them. 2. Students will understand that a variety of patterns, relations, and functions can be used to describe, interpret, represent, and predict real world phenomena. 3. Students will understand how to use tables, graphs, and equations are ways for depicting and analyzing patterns of change in various types of data sets. 4. Students will understand how to use tables, graphs, and equations are ways for depicting and analyzing patterns of change in various types of data sets.
Knowledge/Skills	<ol style="list-style-type: none"> 1. Analyzes characteristics of classes of functions (polynomial, rational, exponential, and logarithmic) to include domain, range, intercepts, increasing and decreasing intervals, maximum and minimum values, asymptotes and rates of change. <ul style="list-style-type: none"> • Recognize, describe, and extend patterns governed by a polynomial, exponential, logarithmic, inverse and direct variation functional relationship. • Identify the domain, range, dependent and independent variables of functions. • Translate between different representations of functions and relations, i.e. graphs, equations, sets of ordered pairs, word descriptions, and tables. • Describe how change in the value of one variable relates to change in the value of the second variable. 2. Understand one-to-one (injective) functions and that a function that is one-to-one has a converse that is also a function; and finds inverses algebraically and graphically. 3. Graphs polynomial, rational, exponential, logarithmic, inverse and direct/indirect variation functions, including vertical and horizontal shifts, stretches, and compressions as well as reflections across vertical and horizontal axes. <ul style="list-style-type: none"> • Determine a graph by describing its geometric properties from the function. • Demonstrate an understanding of the relationship between various representations of a function. • Find solutions to equations through graphical representation. • Given a function display the key features of the graph (e.g. line of symmetry', vertex, x and y-intercepts. asymptotes).

<p>Knowledge/Skills</p>	<p>4. Applies knowledge of functions to interpret and understand situations, design mathematical models, and solve problems in mathematics as well as in the natural and social sciences.</p> <ul style="list-style-type: none"> • Solve ever/day problems that can be modeled using functions and apply appropriate graphical or symbolic methods to the solution. • Solve ever/day problems that can be modeled using systems of equations or inequalities and apply algebraic and graphical methods to solution. • Interprets a given representation(s) (e.g. regression function) to analyze the data to make inferences and to formulate, justify, and critique conclusions. • Analyzes patterns, trends, or distributions in data in a variety of contexts by determining or using estimated line of best fit, regression line, or correlation to solve problems. • Organizes and displays one- and two- variable data using a variety of representations (e.g., scatter plots, linear, quadratic, and exponential regression functions) to analyze data to formulate or justify conclusions, make predictions, or to solve problems across disciplines or contexts.
<p>Process Skills</p>	<ol style="list-style-type: none"> 1. Students will understand that a variety of problem-solving strategies can be used to investigate ever/day as well as increasingly complex mathematical situations. 2. Students will understand that exploring, justifying, and synthesizing mathematical conjectures are part of systemic reasoning which is common to all content areas and a defining feature of mathematics. 3. Students will understand that actively exploring, investigating, describing, and explaining mathematical ideas promotes communication which leads to a greater comprehension of mathematical concepts. 4. Students will understand that mathematical connections will help them become aware of the usefulness of mathematics, serve to bridge the concrete and the abstract, and enable deeper understanding of important ideas. 5. Students will understand that representing ideas and connecting the representations lies at the heart of understanding mathematics

Functions and Algebra Strand – Stem 3	
Demonstrates conceptual understanding of algebraic expressions.	
Topics	Algebraic, numerical, polynomial, rational, radical, exponential, and logarithmic expressions; absolute value, roots, exponents, factoring, order of operations, properties of numbers and field properties
Competencies	<ol style="list-style-type: none"> 1. Students will understand and compare the properties of classes of functions and perform operations and transformations on them. 2. Students will understand that a variety of patterns, relations, functions can be used to describe, interpret, represent, and predict real world phenomena. 3. Students will understand how to use tables, graphs, and equations are ways for depicting and analyzing patterns of change in various types of data sets. 4. Students will understand how to manipulate symbolic statements by mathematical rules to produce equivalent statements and the necessity, importance, and application thereof.
Knowledge/Skills	<ol style="list-style-type: none"> 1. Manipulates, evaluates, and simplifies algebraic and numerical expressions: <ul style="list-style-type: none"> • Polynomial or rational expressions involving integer exponents, square roots or absolute values • Add, subtract, multiply and divide polynomial and rational expressions • Factors quadratic and higher degree polynomials 2. Understands properties of logarithms and converts between logarithmic and exponential forms. 3. Manipulates, evaluates, and simplifies expressions involving rational exponents and radicals and converts between expressions with rational exponents and expressions with radicals. 4. Identifies and is able to explain the effect of simplifying rational expressions on the domain of the related functions. 5. Simplifies complex fractions. 6. Uses the Remainder Theorem, Factor Theorem, and Rational Root Theorem for polynomials. 7. Translates problem situations into algebraic expressions. 8. Applies properties of numbers and field properties to simplify computations
Process Skills	<ol style="list-style-type: none"> 1. Students will understand that a variety of problem-solving strategies can be used to investigate everyday as well as increasingly complex mathematical situations. 2. Students will understand that exploring, justifying, and synthesizing mathematical conjectures are part of systemic reasoning which is common to all content areas and a defining feature of mathematics.

Process Skills	<ol style="list-style-type: none"><li>3. Students will understand that actively exploring, investigating, describing, and explaining mathematical ideas promotes communication which leads to a greater comprehension of mathematical concepts.<li>4. Students will understand that mathematical connections will help them become aware of the usefulness of mathematics, serve to bridge the concrete and the abstract, and enable deeper understanding of important ideas.<li>5. Students will understand that representing ideas and connecting the representations lies at the heart of understanding mathematics.
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Functions and Algebra Strand – Stem 4	
Demonstrates conceptual understanding of equality.	
Topics	Equality; polynomial, exponential, logarithmic, rational, radical, matrix equations and linear and quadratic inequalities; graphical interpretation of solutions; systems of equations
Competencies	<ol style="list-style-type: none"> 1. Students will understand and compare the properties of classes of functions and perform operations and transformations on them. 2. Students will understand that a variety of patterns, relations, and functions can be used to describe, interpret, represent, and predict real world phenomena. 3. Students will understand how to use tables, graphs, and equations are ways for depicting and analyzing patterns of change in various types of data sets. 4. Students will understand how to manipulate symbolic statements by mathematical rules to produce equivalent statements and the necessity, importance, and application thereof.
Knowledge/Skills	<ol style="list-style-type: none"> 1. Factors, completes the square, uses the quadratic formula, and graphs quadratic functions to solve quadratic equations with real and complex roots. 2. Solves equations involving polynomial (both real and complex roots), rational, radical, exponential, and logarithmic expressions. Graphs and interprets the solutions. 3. Understands extraneous solutions. 4. Finds approximate solutions to equations by graphing each side as a function using technology. Understands that any equation in x can be interpreted as the equation $f(x) = g(x)$ and interpret the solutions of the equation as the x-value(s) of the intersection point(s) of the graphs of $y = f(x)$ and $y = g(x)$. 5. Solves 2×2 and 3×3 systems of linear equations and graphically interprets the solutions. 6. Uses matrices or determinants to solve systems of equations with or without technology. 7. Solves systems of linear and quadratic inequalities. 8. Solves systems of equations involving nonlinear expressions and graphically interprets the solutions. 9. Translates problem situations into inequalities; and solves linear and non-linear inequalities (symbolically and graphically)
Process Skills	<ol style="list-style-type: none"> 1. Students will recognize that a variety of problem-solving strategies can be used to investigate ever/day as well as increasingly complex mathematical situations. 2. Students will understand that exploring, justifying and synthesizing mathematical conjectures are part of systematic reasoning which is common to all content areas and a defining feature of mathematics.

Process Skills	<ol style="list-style-type: none">3. Students will understand that actively exploring, investigating, describing, and explaining mathematical ideas promotes communication which leads to a greater comprehension of mathematical concepts.4. Students will recognize that mathematical connections will help them become aware of the usefulness of mathematics, serve to bridge the concrete and the abstract, and enable deeper understanding of important ideas.5. Students will recognize that representing ideas and connecting the representations lies at the heart of understanding mathematics.
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