Algebra II
ECCHS

Algebra II

Units of Study

Unit 1:	Absolute Value Equations, Inequalities, and Functions	9 days	1st semester
Unit 2:	Linear Functions	9 days	1st semester
Unit 3:	Systems of Equations and Inequalities	14 days	1st semester
Unit 4:	Quadratic Functions and Inequalities	20 days	1st semester
Unit 5:	Polynomial Operations and Equations	9 days	2nd semester
Unit 6:	Polynomial Functions	10 days	2nd semester
Unit 7:	Radical Functions and Equations	17 days	2nd semester
Unit 8:	Exponential and Logarithmic Functions and Equations	16 days	2nd semester
Unit 9:	Rational Functions and Equations	15 days	2nd semester
Unit 10:	Probability	12 days	2nd semester
Unit 11:	Data Analysis and Statistics	13 days	2nd semester

Appendices

Appendix A: Proficiency Scale Template

Appendix B: PLC Form

Standards Breakdown

Green: Priority Standards   **Pink:** Supporting Standards

STANDARDS		UNITS 1	2	3	4	5	6	7	8	9	10	11
Polynomial, Rational, and Other Equations and Functions	1					Green	Green					
	2	Green	Green		Green		Green	Green		Green		
	3							Pink		Pink		
	4	Pink										
Functions	1							Pink				
	2							Pink				
	3							Pink				
	4		Pink									
Systems of Equations	1				Pink							
	2			Green								
	3			Pink								
Quadratic Equations and Functions	1				Pink							
	2				Green							
	3				Green							
	4				Pink							
Arithmetic and Structure of Expressions	1							Pink				
	2							Pink				
	3									Green		
	4					Pink						
Exponential and Logarithmic Equations and Functions	1								Green			
	2								Pink			
	3								Pink			
	4								Pink			
	5								Pink			
	6								Pink			
Data Analysis, Statistics, and Probability	1											Green
	2											Green
	3											Pink
	4											Pink
	5										Green	
	6										Pink	

General Description of the Unit

In this unit, students will review solving linear equations and inequalities. Then they will extend this knowledge to solve one-variable absolute value linear equations and inequalities, including graphing the solutions on a number line. Finally, students will extend their understanding of absolute value equations to graphing absolute value functions on a coordinate grid.

Priority Standards	Supporting Standards
• **AII.PR.2:** Graph mathematical functions including: ○ polynomial functions; ○ rational functions; ○ square root functions; ○ absolute value functions; and, ○ piecewise-defined functions with technology. Identify and describe features, such as intercepts, domain and range, end behavior, and lines of symmetry.	• **AII.PR.4:** Solve absolute value linear equations and inequalities in one variable.
Enduring Understandings	**Essential Questions**
• Real-world situations can be modeled with equations and inequalities. When a relationship needs to be exactly the same, an equation is usually used. Inequalities are typically used when a minimum or maximum value is needed. • Absolute value equations and inequalities can be solved by splitting the equation into two equations or inequalities.	• What are the similarities and differences in solving and expressing the solutions to equations and inequalities? • How many solutions do absolute value equations usually have? Why?

Key Concepts	Related Concepts	Vocabulary
• I can graph polynomial functions with technology. (AII.PR.2) • I can graph rational functions with technology. (AII.PR.2) • I can graph square root functions with technology. (AII.PR.2) • I can graph absolute value functions with technology. (AII.PR.2) • I can graph piecewise defined functions with technology. (AII.PR.2) • I can graph mathematical functions and identify and describe key features such as intercepts, domain and range, end behavior, and lines of symmetry. (AII.PR.2)	• I can apply the concept of absolute value to solve absolute value linear equations in one variable. (All.PR.4) • I can discuss the reason for two solutions to absolute value equations. (All.PR.4) • I can solve absolute value linear inequalities in one variable. (All.PR.4)	• Absolute value • Absolute value function • Domain • End behavior • Intercept • Range

Mathematical Processes

- PS.1 Make sense of problems and persevere in solving them.
- PS.6 Attend to precision.

Resources

Proficiency Scales	Digital	Manipulatives
• **AII.PR.2**	• **IDOE Examples/Tasks AII.PR.2** • **IDOE Examples/Tasks AII.PR.4**	• **Coordinate Grid** • **Graphing Calculator** • **Scientific Calculator**

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will review function notation and graphing functions. Then they will extend this knowledge to explore the impact transformations have on a parent function. Students will conclude this unit by graphing piece-wise functions and step functions, which includes an exploration of the key features of these graphs.

Priority Standards

- **AII.PR.2:** Graph mathematical functions including:
  - polynomial functions;
  - rational functions;
  - square root functions;
  - absolute value functions; and,
  - piecewise-defined functions

  with technology. Identify and describe features, such as intercepts, domain and range, end behavior, and lines of symmetry.

Supporting Standards

- **AII.F.4:** Explore and describe the effect on the graph of $f(x)$ by replacing $f(x)$ with $f(x)+k$, $kf(x)$, $f(kx)$, and $f(x+k)$ for specific values of k (both positive and negative) with and without technology. Find the value of k given the graph of $f(x)$ and the graph of $f(x)+k$, $kf(x)$, $f(kx)$, or $f(x+k)$.

Enduring Understandings

- Functions can be represented numerically, algebraically, graphically, and verbally.
- All graphs contain key features that reveal important information about the function and/or situation being modeled.
- Transformations can shift a parent function horizontally and vertically, as well as dilate and reflect.

Essential Questions

- Are there any characteristics that all functions from the same parent function will share? Why or why not?
- How do transformations affect the parent function?

Key Concepts

- I can graph polynomial functions with technology. (AII.PR.2)
- I can graph rational functions with technology. (AII.PR.2)
- I can graph square root functions with technology. (AII.PR.2)
- I can graph absolute value functions with technology. (AII.PR.2)
- I can graph piecewise defined functions with technology. (AII.PR.2)
- I can graph mathematical functions and identify and describe key features such as intercepts, domain and range, end behavior, and lines of symmetry. (AII.PR.2)

Related Concepts

- I can identify the transformations of a function on a graph. (AII.F.4)
- I can describe the effects of transformations on parent functions. (AII.F.4)
- I can determine the value corresponding to various transformations of functions. (AII.F.4)

Vocabulary

- Absolute value function
- Domain
- Horizontal shift
- Horizontal stretch
- Intercept
- Line of symmetry
- Parent function
- Piecewise function
- Range
- Reflection
- Transformation
- Vertical shift
- Vertical stretch

Mathematical Processes

- PS.2 Reason abstractly and quantitatively.
- PS.8 Look for and express regularity in repeated reasoning.

Resources

Proficiency Scales

- AII.PR.2

Digital

- IDOE Examples/Tasks AII.PR.2
- IDOE Examples/Tasks AII.F.4

Manipulatives

- Absolute Value Function Transformations
- Coordinate Grid
- Graphing Calculator
- Scientific Calculator

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will review solving systems of linear equations and inequalities both graphically and algebraically, a topic already covered in Algebra 1. Then they will extend this knowledge to three-variable systems of linear equations and inequalities. The end goal of this unit is that students can model real-world problems with two and three variable systems.

Priority Standards

- **AII.SE.2:** Represent and solve real-world systems of linear equations and inequalities in two or three variables algebraically and using technology. Interpret the solution set and determine whether it is reasonable.

Supporting Standards

- **AII.SE.3:** Represent real-world problems using a system of linear equations in three variables. Understand that the algebraic steps to solve a two variable system can be extended to systems of equations in three variables.

Enduring Understandings

- Systems of equations and inequalities can be solved with graphs, properties of algebra, and technology.
- A typical solution to a system of linear equations is singular, while the solution to a system of linear inequalities is a set of solutions.
- The process for solving a system of equations in three variables is an extension of the algebraic methods of solving a system of equations in two variables.
- Writing and solving a system of linear equations to represent a real-world situation can be an efficient strategy to find a solution for a real-world situation with multiple constraints.

Essential Questions

- How do systems of equations compare to systems of inequalities?
- What key factors should we consider when selecting a method for solving a system of three equations?

Key Concepts

- I can represent a real-world system of two or three linear equations in two or three variables. (AII.SE.2)
- I can solve a real-world system of two or three linear equations in two or three variables algebraically. (AII.SE.2)
- I can solve a real-world system of two or three linear equations in two or three variables using technology. (AII.SE.2)
- I can interpret the solution set to a system of two or three linear equations in two or three variables in context and determine its reasonableness. (AII.SE.2)
- I can represent a real-world system of two or three linear inequalities in two or three variables. (AII.SE.2)
- I can solve a real-world system of two or three linear inequalities in two or three variables algebraically. (AII.SE.2)
- I can solve a real-world system of two or three linear inequalities in two or three variables using technology. (AII.SE.2)
- I can interpret the solution set to a system of two or three linear inequalities in two or three variables

Related Concepts

- I can represent real-world problems using a system of linear equation in three variables. (AII.SE.3)
- I can explain that the algebraic steps to solve a two variable system can be extended to solve a three variable system. (AII.SE.3)

Vocabulary

- Composition
- Elimination method
- Solution
- Solution set
- Substitution method
- System of equations
- System of linear equations

in context and determine its reasonableness. (AII.SE.2)		
Mathematical Processes • PS.5 Use tools appropriately. • PS.7 Look for and make use of structure.		
Resources		
Proficiency Scales • AII.SE.2	**Digital** • IDOE Examples/Tasks AII.SE.2 • IDOE Examples/Tasks AII.SE.3	**Manipulatives** • Coordinate Grid • Graphing Calculator • Scientific Calculator

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will graph quadratic functions in various forms as well as quadratic inequalities while identifying and describing key features of the functions. They will represent quadratic functions, translate among various forms of quadratic functions, and solve them using a variety of methods. Using the discriminant, they will determine the number of solutions to a quadratic equation and will write any complex solutions in standard form. Finally, students will explore systems of equations and inequalities involving a linear equation a quadratic equation.

Priority Standards

- **AII.PR.2:** Graph mathematical functions including:
    - polynomial functions;
    - rational functions;
    - square root functions;
    - absolute value functions; and,
    - piecewise-defined functions

  with technology. Identify and describe features, such as intercepts, domain and range, end behavior, and lines of symmetry.
- **AII.Q.2:** Use completing the square to rewrite quadratic functions in vertex form and graph these functions with and without technology.
- **AII.Q.3:** Understand that different forms of a quadratic equation can provide different information. Use and translate quadratic functions between standard, vertex, and intercept form to graph and identify key features, including intercepts, vertex, line of symmetry, end behavior, and domain and range.

Supporting Standards

- **AII.Q.1:** Represent real-world problems that can be modeled with quadratic functions using tables, graphs, and equations; translate fluently among these representations. Solve such problems with and without technology. Interpret the solutions and determine whether they are reasonable.
- **AII.Q.4:** Use the discriminant to determine the number and type of solutions of a quadratic equation. Find all solutions and write complex solutions in the form of a ± bi for real numbers a and b.
- **AII.SE.1:** Solve a system of equations consisting of a linear equation and a quadratic equation in two variables algebraically and graphically with and without technology.

Enduring Understandings

- Completing the square can be used for more than just solving a quadratic equation; it can also be used to put a quadratic function in vertex form for graphing.
- Different representations (table, graph, equation) of quadratic functions highlight different features of a function. Translating between them can reveal a fuller picture of the function.
- Solving a system of equations involving a linear equation and a quadratic equation can be solved using algebra or by graphing; there will be either 0, 1, or 2 solutions.

Essential Questions

- Would you rather be given a quadratic function in vertex, factored, or standard form to graph? Why?
- How can quadratic functions maximize profits or minimize costs?
- What can the discriminant reveal about the graph of a quadratic equation?
- How does the process of solving a system with a linear equation and a quadratic equation compare to solving a system of linear equations?

Key Concepts

- I can graph polynomial functions with technology. (AII.PR.2)
- I can graph rational functions with technology. (AII.PR.2)
- I can graph square root functions with technology. (AII.PR.2)
- I can graph absolute value functions with technology. (AII.PR.2)
- I can graph piecewise defined functions with technology. (AII.PR.2)
- I can graph mathematical functions and identify and describe key features such as intercepts, domain and range, end behavior, and lines of symmetry. (AII.PR.2)

Related Concepts

- I can represent and solve real-world problems that can be modeled with quadratic functions using a table. (AII.Q.1)
- I can represent and solve real-world problems that can be modeled with quadratic functions using a graph. (AII.Q.1)
- I can represent and solve real-world problems that can be modeled with quadratic functions using an equation. (AII.Q.1)
- I can translate fluently among tables, graphs, and equations of quadratic functions. (AII.Q.1)

Vocabulary

- Completing the square
- Domain
- End behavior
- Intercept
- Intercept form of a quadratic equation
- Line of symmetry
- Linear equation
- Point of intersection
- Quadratic Equation
- Quadratic Function
- Range
- Standard form of a quadratic equation
- System of equations
- Vertex

• I can use the technique of completing the square to rewrite quadratic functions into vertex form. (AII.Q.2) • I can graph quadratic functions in vertex form with technology. (AII.Q.2) • I can graph quadratic functions in vertex form without technology. (AII.Q.2) • I can discuss the advantages and information available in the different forms of a quadratic equation. (AII.Q.3) • I can translate between standard form, vertex form, and intercept form of a quadratic function. (AII.Q.3) • I can identify any intercepts of a quadratic function. (AII.Q.3) • I can find the vertex and axis of symmetry of a quadratic function. (AII.Q.3) • I can determine the domain and range of a quadratic function. (AII.Q.3)	• I can interpret my solution to a quadratic function and determine its reasonableness. (AII.Q.1) • I can identify the discriminant within the quadratic formula. (AII.Q.4) • I can use the discriminant to determine the number and type of solutions to a quadratic equation. (AII.Q.4) • I can find all solutions to a quadratic equation. (AII.Q.4) • I can write complex solutions in the form a ± bi. (AII.Q.4) • I can solve a system of equations consisting of linear and quadratic equations in two variables algebraically. (AII.SE.1) • I can solve a system of equations consisting of linear and quadratic equations in two variables graphically by finding the point(s)s of intersection with technology. (AII.SE.1) • I can solve a system of equations consisting of linear and quadratic equations in two variables graphically by finding the point(s)s of intersection without technology. (AII.SE.1)	• Vertex form of a quadratic equation

Mathematical Processes

- PS.5 Use tools appropriately.
- PS.6 Attend to precision.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.PR.2 • AII.Q.2 • AII.Q.3	• IDOE Examples/Tasks AII.PR.2 • IDOE Examples/Tasks AII.Q.2 • IDOE Examples/Tasks AII.Q.3 • IDOE Examples/Tasks AII.Q.1 • IDOE Examples/Tasks AII.Q.4 • IDOE Examples/Tasks AII.SE.1	• Coordinate Grid • Graphing Calculator • Scientific Calculator

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit students will explore polynomial expressions and equations. They will rewrite rational expressions using various methods, including long division and synthetic division. They'll also extend factoring techniques to higher-order polynomials. Students will also review complex numbers and the properties of exponents.

Priority Standards

- **AII.PR.1:** Solve real-world and other mathematical problems involving polynomial equations with and without technology. Interpret the solutions and determine whether the solutions are reasonable.

Supporting Standards

- **AII.ASE.4:** Rewrite rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$.

Enduring Understandings

- Rational expressions with a higher degree in the numerator than the denominator can be rewritten using long division or synthetic division.
- Many quadratic factoring techniques can be extended to higher-order polynomials.

Essential Questions

- When using a polynomial model for a real-world situation, are the solutions always reasonable? Why or why not?
- Why do we want to perform division on polynomials? What new information can it reveal?

Key Concepts

- I can solve real-world polynomial equations with technology. (AII.PR.1)
- I can solve real-world polynomial equations without technology. (AII.PR.1)
- I can solve mathematical problems involving polynomial equations with technology. (AII.PR.1)
- I can solve mathematical problems involving polynomial equations without technology. (AII.PR.1)
- I can interpret the solutions to a polynomial equation and determine the reasonableness of them. (AII.PR.1)

Related Concepts

- I can rewrite rational expressions using long division. (AII.ASE.4)
- I can identify the degree of a polynomials. (AII.ASE.4)
- I can rewrite rational expressions using synthetic division. (AII.ASE.4)
- I can identify the divisor to use in order to perform synthetic division. (AII.ASE.4)

Vocabulary

- Degree
- Polynomial
- Polynomial equation
- Polynomial long division
- Rational expression
- Solution
- Synthetic division

Mathematical Processes

- PS.2 Reason abstractly and quantitatively.
- PS.3 Construct convincing arguments and critique the reasoning of others.

Resources

Proficiency Scales

- **AII.PR.1**

Digital

- **IDOE Examples/Tasks AII.PR.1**
- **IDOE Examples/Tasks AII.ASE.4**

Manipulatives

- **Coordinate Grid**
- **Graphing Calculator**
- **Scientific Calculator**

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit In this unit, students will graph polynomial functions using technology and will describe the qualitative features of the functions. Students will write and solve polynomial equations both algebraically and with the corresponding graph.	
Priority Standards • **AII.PR.1:** Solve real-world and other mathematical problems involving polynomial equations with and without technology. Interpret the solutions and determine whether the solutions are reasonable. • **AII.PR.2:** Graph mathematical functions including: o polynomial functions; o rational functions; o square root functions; o absolute value functions; and, o piecewise-defined functions with technology. Identify and describe features, such as intercepts, domain and range, end behavior, and lines of symmetry.	**Supporting Standards** None
Enduring Understandings • Polynomial functions and their graphs can be a useful model for many real-world situations. • All graphs contain key features that reveal important information about the function and/or situation being modeled.	**Essential Questions** • When using a polynomial model for a real-world situation, are the solutions always reasonable? Why or why not? • Are there any characteristics that all polynomial functions will share? Why or why not?

Key Concepts	**Related Concepts**	**Vocabulary**
• I can solve real-world polynomial equations with technology. (AII.PR.1) • I can solve real-world polynomial equations without technology. (AII.PR.1) • I can solve mathematical problems involving polynomial equations with technology. (AII.PR.1) • I can solve mathematical problems involving polynomial equations without technology. (AII.PR.1) • I can interpret the solutions to a polynomial equation and determine the reasonableness of them. (AII.PR.1) • I can graph polynomial functions with technology. (AII.PR.2) • I can graph rational functions with technology. (AII.PR.2) • I can graph square root functions with technology. (AII.PR.2) • I can graph absolute value functions with technology. (AII.PR.2) • I can graph piecewise defined functions with technology. (AII.PR.2) • I can graph mathematical functions and identify and describe key features such as intercepts, domain		• Absolute value function • Asymptote • Domain • End behavior • Intercept • Line of symmetry • Piecewise function • Polynomial equation • Polynomial function • Range • Rational function • Solution • Square-root function

and range, end behavior, and lines of symmetry. (AII.PR.2)		

Mathematical Processes
- PS.1 Make sense of problems and persevere in solving them.
- PS.6 Attend to precision.

Resources		
Proficiency Scales • AII.PR.1 • AII.PR.2	**Digital** • IDOE Examples/Tasks AII.PR.1 • IDOE Examples/Tasks AII.PR.2	**Manipulatives** • Coordinate Grid • Graphing Calculator • Scientific Calculator

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

Unit 7: In this unit, students will rewrite radical expressions, translating between radical and exponent notation. They will evaluate and simplify the expressions using laws of exponents. Students will extend this knowledge to graph square root functions and solve radical equations. Finally, students will explore function compositions and inverse functions.

Priority Standards

- **AII.PR.2:** Graph mathematical functions including:
    - polynomial functions;
    - rational functions;
    - square root functions;
    - absolute value functions; and,
    - piecewise-defined functions

with technology. Identify and describe features, such as intercepts, domain and range, end behavior, and lines of symmetry.

Supporting Standards

- **AII.ASE.1:** Explain how extending the properties of integer exponents to rational numbers allows for a notation for radicals in terms of rational exponents (e.g. $5^{\frac{1}{3}}$ is defined to be the cube root of 5 because we want $\left(5^{\frac{1}{3}}\right)^3 = 5^{\left[\left(\frac{1}{3}\right)3\right]}$ to hold, so $\left(5^{\frac{1}{3}}\right)^3$ must equal 5.)
- **AII.ASE.2:** Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- **AII.F.1:** Understand composition of functions and combine functions by composition.
- **AII.F.2:** Define and find the inverse of a function. Verify functions are inverses algebraically and graphically.
- **AII.F.3:** Understand that if the graph of a function contains a point (a, b), then the graph of the inverse relation of the function contains the point (b, a); the inverse is a reflection over the line $y = x$.
- **AII.PR.3:** Solve real-world and other mathematical problems involving radical and rational equations. Give examples showing how extraneous solutions may arise.

Enduring Understandings

- Expressing radicals as rational exponents allows exponent rules to be extended to radicals.
- Inverse functions "undo" the original function; this can be verified algebraically or graphically.
- Some solutions to radical equations may be extraneous and therefore are invalid solutions to the equation.

Essential Questions

- Do you prefer to use rational exponent notation or radical notation? Why?
- If a real-world situation is modeled by a composition of two functions, $(f(g(x))$, does the opposite composition, $g(f(x))$, always have meaning? Why or why not?
- Is it possible to identify a radical equation as having no real roots just by looking at it? Why or why not?

Key Concepts

- I can graph polynomial functions with technology. (AII.PR.2)
- I can graph rational functions with technology. (AII.PR.2)
- I can graph square root functions with technology. (AII.PR.2)
- I can graph absolute value functions with technology. (AII.PR.2)
- I can graph piecewise defined functions with technology. (AII.PR.2)
- I can graph mathematical functions and identify and describe key features such as intercepts, domain and range, end behavior, and lines of symmetry. (AII.PR.2)

Related Concepts

- I can relate the properties of exponents with integers as being the same as the properties of exponents with rational numbers. (AII.ASE.1)
- I can connect rational exponents to their equivalent radical from. (AII.ASE.1)
- I can translate expressions between radical and exponent form. (AII.ASE.2)
- I can simplify expressions written in exponent form with rational exponents using the laws of exponents. (AII.ASE.2)
- I can combine functions by substituting one function in for the other. (AII.F.1)
- I can understand and explain the process of composing functions. (AII.F.1)

Vocabulary

- Composition of functions
- Dependent variable
- Domain
- End behavior
- Exponent
- Exponential expression
- Extraneous solution
- Function
- Horizontal line test
- Independent variable
- Integer
- Intercept
- Inverse function
- Inverse relationship
- Line of symmetry
- One-to-one
- Piecewise function
- Power of a power
- Power of a product
- Power of a quotient

	• I can give a definition for the inverse of a function. (AII.F.2) • I can find the inverse of a function. (AII.F.2) • I can understand the idea that the inverse of a function "undoes" anything the original function does. (AII.F.2) • I can determine whether a function has an inverse. (AII.F.2) • I can determine if a function is one-to-one. (AII.F.2) • I can verify if two functions are inverses of each other algebraically. (AII.F.2) • I can verify if two functions are inverses of each other graphically. (AII.F.2) • I can understand the domain of a function is the range of the inverse, and vice versa. (AII.F.3) • I can graph a function and its inverse to show that the inverse is a reflection of the function over the line y= x. (AII.F.3) • I can solve real-world problems involving rational functions. (AII.PR.3) • I can solve real-world problems involving radical functions. (AII.PR.3) • I can solve mathematical problems involving rational functions. (AII.PR.3) • I can solve mathematical problems involving radical functions. (AII.PR.3) • I can identify and understand extraneous solutions and the situations in which they arise. (AII.PR.3)	• Product of powers • Properties of exponents • Quotient of powers • Radical • Radical expression • Radical function • Range • Rational function • Rational number • Reflection • Square-root function

Mathematical Processes

- PS.7 Look for and make use of structure.
- PS.8 Look for and express regularity in repeated reasoning.

Resources

Proficiency Scales	**Digital**	**Manipulatives**
• **AII.PR.2**	• **IDOE Examples/Tasks AII.PR.2** • **IDOE Examples/Tasks AII.ASE.1** • **IDOE Examples/Tasks AII.ASE.2** • **IDOE Examples/Tasks AII.F.1** • **IDOE Examples/Tasks AII.F.2** • **IDOE Examples/Tasks AII.F.3** • **IDOE Examples/Tasks AII.PR.3**	• **Absolute Value Function Transformations** • **Coordinate Grid** • **Graphing Calculator** • **Scientific Calculator**

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will explore exponential and logarithmic functions. They will simplify and evaluate expressions involving natural base e. Then students will use the laws of logarithms and exponents to rewrite, evaluate, and simplify logarithmic expressions. They will use the properties of exponents and logarithms to solve both exponential and logarithmic equations. Finally, students will graph exponential and logarithmic functions, exploring their inverse relationship graphically.

Priority Standards

- **AII.EL.1:** Graph exponential and logarithmic functions with and without technology. Identify and describe key features, such as intercepts, domain and range, asymptotes and end behavior. Know that the inverse of an exponential function is a logarithmic function.

Supporting Standards

- **AII.EL.2:** Identify the percent rate of change in exponential functions. Classify them as representing exponential growth or decay.
- **AII.EL.3:** Use the properties of exponents to rewrite expressions to describe transformations of exponential functions.
- **AII.EL.4:** Use the properties of exponents to derive the properties of logarithms. Evaluate exponential and logarithmic expressions.
- **AII.EL.5:** Solve exponential and logarithmic equations in one variable.
- **AII.EL.6:** Represent real-world problems using exponential and logarithmic functions and solve such problems with technology. Interpret the solutions and determine whether they are reasonable.

Enduring Understandings

- Exponential functions and logarithmic functions are inverses; therefore, their graphs are reflections over the line $y = x$.
- Using the fact that exponential functions and logarithmic functions are inverses, the properties of exponents can be extended to logarithms.
- Solving exponential and logarithmic equations takes creativity and a variety of approaches.
- Exponential and logarithmic functions are often good models of growth or decay, such as that in bank accounts or populations.

Essential Questions

- How are exponential functions and logarithmic functions related?
- How does the change in a linear function differ from that in an exponential function? How is it similar?
- Why are logarithms important?
- What are key features of an exponential or logarithmic equation that help reveal a path for solving it?

Key Concepts

- I can graph exponential functions with technology. (AII.EL.1)
- I can graph exponential functions without technology. (AII.EL.1)
- I can graph logarithmic functions with technology. (AII.EL.1)
- I can graph logarithmic functions without technology. (AII.EL.1)
- I can identify and describe key features of exponential functions such as intercepts, domain and range, and asymptotic and end behavior. (AII.EL.1)
- I can identify and describe key features of logarithmic functions such as intercepts, domain and range, and asymptotic and end behavior. (AII.EL.1)
- I can effectively communicate that the inverse of an exponential

Related Concepts

- I can identify the percent rate of change in an exponential function. (AII.EL.2)
- I can classify an exponential function as representing growth or decay based upon the percent rate of change. (AII.EL.2)
- I can distinguish between the growth or decay rate and the factor by which something grows or decays. (AII.EL.2)
- I can use the properties of exponents to rewrite expressions for exponential functions. (AII.EL.3)
- I can describe transformations of exponential functions. (AII.EL.3)
- I can use the properties of exponents to derive the properties of logarithms. (AII.EL.4)

Vocabulary

- Asymptote
- Decay rate
- Domain
- End behavior
- Exponential decay
- Exponential equation
- Exponential expression
- Exponential function
- Exponential growth
- Factor
- Growth rate
- Initial value
- Intercepts
- Inverse
- Logarithmic equation
- Logarithmic expression
- Logarithmic function
- Percent rate of change
- Properties of exponents
- Properties of logarithms

function is a logarithmic function. (AII.EL.1)	• I can evaluate exponential expressions. (AII.EL.4) • I can evaluate logarithmic expressions. (AII.EL.4) • I can solve exponential equations in one variable. (AII.EL.5) • I can solve logarithmic equations in one variable. (AII.EL.5) • I can represent real-world problems using exponential functions in one variable. (AII.EL.6) • I can represent real-world problems using logarithmic functions in one variable. (AII.EL.6) • I can solve real-world exponential equations using technology. (AII.EL.6) • I can solve real-world logarithmic equations using technology. (AII.EL.6) • I can interpret my solution to an exponential equation and determine the reasonableness of it. (AII.EL.6) • I can interpret my solution to a logarithmic equation and determine the reasonableness of it. (AII.EL.6)	• Range • Solution • Transformation

Mathematical Processes

- PS.1 Make sense of problems and persevere in solving them.
- PS.4 Model with mathematics.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.EL.1	• IDOE Examples/Tasks AII.EL.1 • IDOE Examples/Tasks AII.EL.2 • IDOE Examples/Tasks AII.EL.3 • IDOE Examples/Tasks AII.EL.4 • IDOE Examples/Tasks AII.EL.5 • IDOE Examples/Tasks AII.EL.6	• Coordinate Grid • Graphing Calculator • Scientific Calculator

School Resources

Textbook	Formative Assessments

General Description of the Unit

In this unit, students will write rational equations and use them to solve real world problems. They will determine when solutions are extraneous and explain their reasoning. Students will simplify and perform operations with rational expressions. They will graph rational functions and identifying key features, including asymptotes.

Priority Standards

- **AII.ASE.3:** Rewrite algebraic rational expressions in equivalent forms (e.g., using properties of exponents and factoring techniques). Add, subtract, multiply, and divide algebraic rational expressions.
- **AII.PR.2:** Graph mathematical functions including:
    - polynomial functions;
    - rational functions;
    - square root functions;
    - absolute value functions; and,
    - piecewise-defined functions

with technology. Identify and describe features, such as intercepts, domain and range, end behavior, and lines of symmetry.

Supporting Standards

- **AII.PR.3:** Solve real-world and other mathematical problems involving radical and rational equations. Give examples showing how extraneous solutions may arise.

Enduring Understandings

- Rational expressions can be simplified and rearranged by applying properties of fractions and factoring.
- Some solutions to rational equations may be extraneous and therefore are invalid solutions to the equation.

Essential Questions

- How do I know when a rational function is simplified?
- Is it possible to identify a radical equation as having no real roots just by looking at it? Why or why not?

Key Concepts

- I can rewrite algebraic rational expressions in equivalent forms using the properties of exponents. (AII.ASE.3)
- I can rewrite algebraic rational expressions in equivalent forms using factoring techniques. (AII.ASE.3)
- I can add and subtract rational expressions with common denominators. (AII.ASE.3)
- I can add and subtract rational expressions without common denominators. (AII.ASE.3)
- I can multiply and divide rational expressions. (AII.ASE.3)
- I can graph polynomial functions with technology. (AII.PR.2)
- I can graph rational functions with technology. (AII.PR.2)
- I can graph square root functions with technology. (AII.PR.2)
- I can graph absolute value functions with technology. (AII.PR.2)
- I can graph piecewise defined functions with technology. (AII.PR.2)
- I can graph mathematical functions and identify and describe key features such as intercepts, domain

Related Concepts

- I can solve real-world problems involving rational functions. (AII.PR.3)
- I can solve real-world problems involving radical functions. (AII.PR.3)
- I can solve mathematical problems involving rational functions. (AII.PR.3)
- I can solve mathematical problems involving radical functions. (AII.PR.3)
- I can identify and understand extraneous solutions and the situations in which they arise. (AII.PR.3)

Vocabulary

- Algebraic rational expression
- Asymptote
- Common denominator
- Domain
- End behavior
- Extraneous solution
- Intercept
- Line of symmetry
- Properties of exponents
- Range
- Rational function
- Rational numbers

and range, end behavior, and lines of symmetry. (AII.PR.2)		
Mathematical Processes • PS.7 Look for and make use of structure. • PS.8 Look for and express regularity in repeated reasoning.		
Resources		
Proficiency Scales • AII.ASE.3 • AII.PR.2	**Digital** • IDOE Examples/Tasks AII.ASE.3 • IDOE Examples/Tasks AII.PR.2 • IDOE Examples/Tasks AII.PR.3	**Manipulatives** • Coordinate Grid • Graphing Calculator • Scientific Calculator

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will utilize the fundamental counting principle, permutations, and combinations to calculate probabilities of various events. Students will examine the difference between independent, mutually exclusive, and dependent events and use these concepts to calculate probabilities.

Priority Standards

- **AII.DSP.5:** Understand dependent and independent events, and conditional probability; apply these concepts to calculate probabilities.

Supporting Standards

- **AII.DSP.6:** Understand the Fundamental Counting Principle, permutations, and combinations; apply these concepts to calculate probabilities.

Enduring Understandings

- When two events are dependent, one event influences the probability of the other and needs to be considered when calculating the probability of both events.
- Probability calculations can be applied to solve problems and make decisions.
- Permutations and combinations are used to count the number of objects in an event; order matters for a permutation, but not for a combination.

Essential Questions

- Why is it important to know if events are dependent or independent when calculating probabilities?
- How can probabilities be used to analyze and make fair decisions?
- How can probabilities be used to analyze and make fair decisions?

Key Concepts

- I can distinguish between dependent, independent events and conditional probability. (AII.DSP.5)
- I can apply properties of dependent events and independent events to calculate probabilities. (AII.DSP.5)

Related Concepts

- I can effectively communicate the Fundamental Counting Principle. (AII.DSP.6)
- I can distinguish between a permutation and a combination. (AII.DSP.6)
- I can apply the properties of permutations and combinations to calculate probabilities. (AII.DSP.6)
- I can understand the necessity for and use of factorial notation. (AII.DSP.6)
- I can use factorial notation when calculating permutations and combinations. (AII.DSP.6)

Vocabulary

- Combination
- Conditional probability
- Dependent event
- Factorial
- Fundamental Counting Principle
- Independent event
- Permutation

Mathematical Processes

- PS.2 Reason abstractly and quantitatively.
- PS.3 Construct convincing arguments and critique the reasoning of others.

Resources

Proficiency Scales

- AII.DSP.5

Digital

- IDOE Examples/Tasks AII.DSP.5
- IDOE Examples/Tasks AII.DSP.6

Manipulatives

- **Deck of Cards**
- Dice
- Virtual Probability Simulators
- Scientific Calculator
- Spinner

School Resources	
Textbook	**Formative Assessments**

General Description of the Unit

In this unit, students will study sampling methods for collecting data and identify biased samples. They will design their own experiments to make inferences from sample results. Students will utilize measures of center and spread to interpret and compare data. Students will learn to choose and construct the best model (linear, quadratic, or exponential) to represent a set of data and make predictions.

Priority Standards

- **AII.DSP.1:** Distinguish between random and non-random sampling methods, identify possible sources of bias in sampling, describe how such bias can be controlled and reduced, evaluate the characteristics of a good survey and well-designed experiment, design simple experiments or investigations to collect data to answer questions of interest, and make inferences from sample results.
- **AII.DSP.2:** Interpret and compare univariate data using measures of center (mean and median) and spread (range, inter-quartile range, standard deviation, and variance). Understand the effects of outliers on the statistical summary of the data.

Supporting Standards

- **AII.DSP.3:** Use technology to find a linear, quadratic, or exponential function that models a relationship for a bivariate data set to make predictions; Interpret the correlation coefficient for linear models.
- **AII.DSP.4:** Using the results of a simulation, decide if a specified model is consistent to those results. Construct a theoretical model and apply the law of large numbers to show the relationship between the two models.

Enduring Understandings

- It is important to have well designed experiments; sampling methods, survey questions, and experiment protocols all need to be considered.
- Models for data can be used to make predictions; it is important to pick the best model (e.g., linear, quadratic, exponential) for each data set.
- Theoretical probability is the expected probability that an event happens; experimental probability is the result from an actual experiment. These two probabilities can be compared to find discrepancies in the results.

Essential Questions

- What is an example of a bad survey question? How could it be improved?
- What features of a data set should be considered to select the best function-type to use a model?
- In an excellent experiment, will the theoretical probability and experimental probability be the same? Why or why not?

Key Concepts

- I can determine whether a sampling method was random or non-random. (AII.DSP.1)
- I can identify various sampling methods, including, but not limited to, simple random sampling, stratified random sampling, stratified and convenience sampling. (AII.DSP.1)
- I can determine if there is bias present in a sampling method. (AII.DSP.1)
- I can suggest ways to control and prevent bias in sampling. (AII.DSP.1)
- I can give qualities of a good survey or experiment. (AII.DSP.1)
- I can use the results from a sample to make inferences about a population. (AII.DSP.1)
- I can design simple experiments to collect data to answer questions. (AII.DSP.1)
- I can interpret and compare univariate data using measures of

Related Concepts

- I can use technology to fit a linear, quadratic, or exponential model to a relationship for a bivariate data set. (AII.DSP.3)
- I can make predictions using an appropriate model for a bivariate data set. (AII.DSP.3)
- I can use technology to compute the correlation coefficient. (AII.DSP.3)
- I can interpret the correlation coefficient of an appropriate model for a bivariate data set. (AII.DSP.3)
- I can use the results of a simulation to decide if a specified model is consistent to those results. (AII.DSP.4)
- I can construct a theoretical model. (AII.DSP.4)
- I can apply the law of large numbers to show the relationship between a theoretical model and an empirical model. (AII.DSP.4)

Vocabulary

- Bias
- Bivariate data
- Correlation coefficient
- Empirical model
- Experiment
- Exponential function
- Inference
- Interquartile range (IQR)
- Law of Large Numbers
- Linear function
- Mean
- Median
- Non-random sampling
- Outlier
- Quadratic function
- Random sampling
- Range
- Simulation
- Standard deviation
- Survey
- Theoretical model
- Univariate data
- Variance

center, including median and mean. (AII.DSP.2) • I can interpret and compare univariate data using measures of spread, including range, interquartile range, standard deviation, and variance. (AII.DSP.2) • I can identify outliers, if any, in a data set. (AII.DSP.2) • I can effectively communicate the effects of outliers on the statistical summary of univariate data. (AII.DSP.2)		
Mathematical Processes • PS.2 Reason abstractly and quantitatively. • PS.3 Construct convincing arguments and critique the reasoning of others.		
Resources		
Proficiency Scales • AII.DSP.1 • AII.DSP.2	**Digital** • IDOE Examples/Tasks AII.DSP.1 • IDOE Examples/Tasks AII.DSP.2 • IDOE Examples/Tasks AII.DSP.3 • IDOE Examples/Tasks AII.DSP.4	**Manipulatives** • Coordinate Grid • Graphing Calculator • Scientific Calculator • Univariate Data Displays

School Resources	
Textbook	**Formative Assessments**