North Gibson School Corporation

High School Algebra II
SY 2022/2023

High School Algebra II

Units of Study

Unit 1:	Relations and Functions	17 days	1st semester
Unit 2:	Linear Equations, Inequalities, and Systems	20 days	1st semester
Unit 3:	Quadratic Functions	19 days	1st semester
Unit 4/5:	Polynomial Equations and Functions	19 days	1st semester
Unit 6:	Inverses and Radical Functions	17 days	2nd semester
Unit 7:	Exponential Equations	13 days	2nd semester
Unit 8:	Logarithmic Functions	14 days	2nd semester
Unit 9:	Rational Functions	15 days	2nd semester
Unit 10:	Inferential Statistics	16 days	2nd semester

Appendices

Appendix A: Proficiency Scale Template

Appendix B: Curriculum Refinement Form

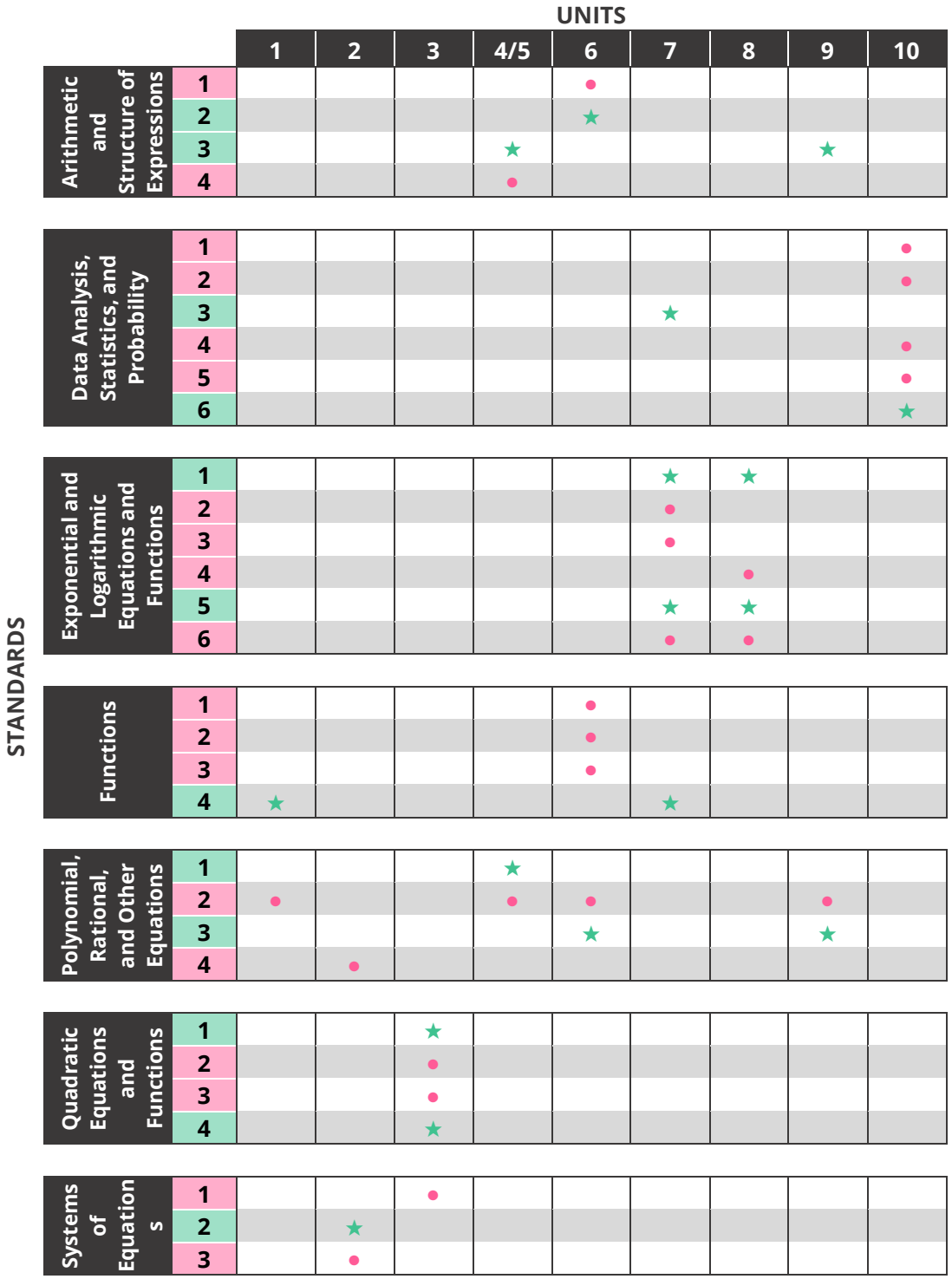
Appendix C: North Gibson Priority Standards Vertical Articulation Document

High School Algebra II Priority Standards

Priority Standards	**AII.ASE.2**	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
	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.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.6	Understand the Fundamental Counting Principle, permutations, and combinations; apply these concepts to calculate probabilities.
	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.
	AII.EL.5	Solve exponential and logarithmic equations in one variable.
	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, k f(x), f(kx), or f(x + k).
	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.3	Solve real-world and other mathematical problems involving radical and rational equations. Give examples showing how extraneous solutions may arise.
	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.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.

Standards Breakdown

★: Priority Standards ●: Supporting Standards —: Additional Standards



General Description of the Unit

This unit is a combination of a review of concepts from Algebra 1, along with the introduction to transformations of functions. Piecewise-defined functions and absolute value functions are graphed for the first time.

Priority 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, k f(x), f(kx), or f(x + k).

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.

Enduring Understandings

- Transformations can shift a parent function horizontally and vertically, as well as dilate and reflect.
- All graphs contain key features that reveal important information about the function and/or situation being modeled. Function families often share some key features.

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 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)

Related Concepts

- 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)

Vocabulary

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

Mathematical Processes

- PS.1 Make sense of problems and persevere in solving them.
- PS.2 Reason abstractly and quantitatively.

Resources

Proficiency Scales

- AII.F.4

Digital

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

Manipulatives

- Graph Paper
- Graphing Calculator
- Scientific Calculator
- Virtual Graph Paper

School Resources	
Textbook Textbook: Indiana Reveal by McGraw-Hill Module 1: Relations and Functions 1.1 Functions and Continuity (SKIP) 1.2 Linearity, Intercepts, and Symmetry: AII.PR.2 1.3 Extrema and End Behavior: AII.PR.2 1.4 Sketching Graphs and Comparing Functions: AII.PR.2 1.5 Graphing Linear Functions and Inequalities: (Review) 1.6 Special Functions (Piecewise and Step Functions): AII.PR.2 1.7 Transformations of Functions: AII.F.4	**Formative Assessments**

General Description of the Unit

This systems unit builds on the extensive work students completed over systems of equations in Algebra 1. The beginning of the unit is an opportunity to review linear equations; then, students will solve absolute value equations and inequalities for the first time. Next, students will work with systems involving three equations or inequalities, solving them algebraically and with technology. Most importantly, students will model and solve real-world situations with these 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.
- **AII.PR.4:** Solve absolute value linear equations and inequalities in one variable.

Enduring Understandings

- 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.
- 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.
- Absolute value equations and inequalities can be solved by splitting the equation into two equations or inequalities.

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?
- How many solutions do absolute value equations usually have? Why?

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)

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)
- 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)

Vocabulary

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

• I can interpret the solution set to a system of two or three linear inequalities in two or three variables in context and determine its reasonableness. (AII.SE.2)		

Mathematical Processes

- PS.6 Attend to precision.
- PS.7 Look for and make use of structure.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.SE.2	• IDOE Examples/Tasks AII.SE.2 • IDOE Examples/Tasks AII.SE.3 • IDOE Examples/Tasks AII.PR.4	• Graph Paper • Graphing Calculator • Scientific Calculator • Virtual Graph Paper

School Resources

Textbook	Formative Assessments
Module 2: Linear Equations, Inequalities, and Systems 2.1 Solving Linear Equations and Inequalities (Review) 2.2 Solving absolute value equations and inequalities: AII.PR.4 2.3 Equations of Linear Functions (Review) 2.4 Solving Systems of Equations Graphically: AII.SE.2 2.5 Solving Systems of Equations Algebraically: AII.SE.2 2.6 Solving Systems of Inequalities: AII.SE.2 2.7 Optimization with Linear Programming: AII.SE.2 2.8 Systems of Equations in Three Variables: AII.SE.2, AII.SE.3 2.9 Solving Absolute Value Equations and Inequalities by Graphing: (Optional Extension)	

General Description of the Unit

In this unit students will extend their understanding of quadratic equations and functions. In Algebra 1, students solved quadratic equations and sketched graphs of quadratic functions. This year, the discriminant will be introduced for the first time; additionally, students will solve quadratic equations to find all solutions (both real and complex). While solving quadratic equations is a part of the unit, the focus is on graphing quadratic functions with and without technology. Students will apply many of the algebraic skills they've developed with quadratic equations to translate the quadratic function into different forms, such as completing the square to put the function in vertex form or factoring to put the function in factored form. Students should use the different forms of the equation to identify different key features of the graph. Additionally, they will work with a system involving a linear and a quadratic equation, solving it both algebraically and graphically. Finally, students will use all these skills to solve real-world problems that can be modeled with quadratic functions.

Priority 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.

Supporting Standards

- **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.
- **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

- Different forms (vertex, standard, factored) and representations (table, graph, equation) of quadratic functions highlight different features of a function. Translating between them can reveal a fuller picture of the function.
- Quadratic functions can represent real-world situations that are parabolic like determining a product's profit, formulating the speed of an object, calculating the height of a ball thrown in the air, and more.
- 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.
- The discriminant comes from the quadratic formula and reveals the number and type of solutions to a quadratic equation.
- 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 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

Related Concepts

- 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)

Vocabulary

- Completing the square
- Complex solutions
- Discriminant
- Domain
- End behavior
- Intercept
- Intercept form of a quadratic equation
- Line of symmetry
- Linear equation

quadratic functions using an equation. (AII.Q.1) • I can translate fluently among tables, graphs, and equations of quadratic functions. (AII.Q.1) • 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 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 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)	• Point of intersection • Quadratic Equation • Quadratic Formula • Quadratic Function • Range • Standard form of a quadratic equation • System of equations • Vertex • Vertex form of a Quadratic Equation

Mathematical Processes

- PS.5 Use tools appropriately.
- PS.8 Look for and express regularity in repeated reasoning.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.Q.1 • AII.Q.4	• IDOE Examples/Tasks AII.Q.1 • IDOE Examples/Tasks AII.Q.4 • IDOE Examples/Tasks AII.Q.2 • IDOE Examples/Tasks AII.Q.3 • IDOE Examples/Tasks AII.SE.1	• Graph Paper • Graphing Calculator • Scientific Calculator • Virtual Graph Paper

School Resources	
Textbook Module 3: Quadratic Functions 3.1 Graphing Quadratic Functions: AII.Q.1, AII.Q.3, AII.DSP.3 3.2 Solving Quadratic Equations by Graphing: AII.Q.1, AII.Q.3, AII.DSP.3 3.3 Complex Numbers (not entirely an Algebra II IAS): AII.Q.4 3.4 Solving Quadratic Equations by Factoring: AII.Q.1, AII.Q.3 3.5 Solving Quadratic Equations by Completing the Square: AII.Q.1, AI.Q.2, AII.Q.3, AII.Q.4 3.6 Using the Quadratic Formula and the Discriminant: AII.Q.1, AII.Q.3, AII.Q.4 3.7 Quadratic Inequalities (SKIP) 3.8 Solving Linear and Nonlinear Systems: AII.SEI.1	**Formative Assessments**

General Description of the Unit

Up until this point, students have mostly worked with only one type of polynomial: quadratics. Now, students will extend their understanding of quadratics to polynomials with higher degrees. Students will graph polynomial functions using technology and will identify key features, such as extrema, intercepts, and end behavior, from the graph. Students will also solve polynomial equations using techniques such as factoring and finding the x-intercepts with a graphing calculator; this includes significant work simplifying algebraic expressions. Finally, students will solve real-world problems that involve polynomial equations.

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.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 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).
- **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.

Enduring Understandings

- Rational expressions can be simplified and rearranged by applying properties of fractions, factoring, and properties of exponents.
- Polynomial functions and their graphs can be a useful model for many real-world situations, especially those involving finance and business.
- Many factoring techniques can be applied to higher degree polynomials.
- Rational expressions with a higher degree in the numerator than the denominator can be rewritten using long division or synthetic division.

Essential Questions

- How do I know when a rational function is simplified?
- 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?
- Why do we want to perform division on polynomials? What new information can it reveal?

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 solve real-world polynomial equations with technology. (AII.PR.1)
- I can solve real-world polynomial equations without technology. (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)
- I can graph polynomial 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)

Vocabulary

- Algebraic rational expression
- Asymptote
- Common denominator
- Degree
- Domain
- End behavior
- Intercept
- Line of symmetry
- Polynomial
- Polynomial equation
- Polynomial function
- Polynomial long division
- Properties of exponents
- Range
- Rational expression
- Rational numbers
- Solution
- Synthetic division

• 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)		

Mathematical Processes

- PS.3 Construct convincing arguments and critique the reasoning of others.
- PS.7 Look for and make use of structure.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.PR.1 • AII.ASE.3	• IDOE Examples/Tasks AII.ASE.3 • IDOE Examples/Tasks AII.PR.1 • IDOE Examples/Tasks AII.ASE.4 • IDOE Examples/Tasks AII.PR.2	• Graph Paper • Graphing Calculator • Scientific Calculator • Virtual Graph Paper

School Resources

Textbook	Formative Assessments
Module 4: Polynomials and Polynomial Functions 4.1 Polynomial Functions: AII.PR.1, AII.PR.2 4.2 Analyzing Graphs of Polynomial Functions: AII.PR.1, AII.PR.2 4.3 Operations with Polynomials: AII.PR.1 4.4 Dividing Monomials: AII.ASE.3, AII.ASE.4, AII.PR.1 4.5 Powers of Binomials: AII.ASE.3, AII.PR.1 (Optional) Module 5: Polynomial Equations 5.1 Solving Polynomial Equations by Graphing: AII.PR.1, AII.PR.2 5.2 Solving Polynomial Equations Algebraically: AII.PR.1 5.3 Proving Polynomial Identities (SKIP) 5.4 The Remainder and Factor Theorems: (Optional/SKIP - PC Standard) 5.5 Roots and Zeros: (Optional/SKIP - PC Standard)	

General Description of the Unit

In this unit, students work with radical equations and functions. They will start with some number sense as they extend exponents to include rational exponents as a new way of representing radicals. Then students will apply this number sense to simplify expressions involving radicals and rational exponents using the properties of exponents. Then students will extend these techniques to solving radical equations, including ones that are modeling a real-world situation; students will also check for extraneous solutions. Finally, students will graph radical functions (mainly the square root function) using technology and transformations. This will lead into the definition of an inverse function as students explore the relationship between a quadratic function and square root function. Students will work formally with the inverse as they find the inverse of a function, verify that two functions are inverses, and understand the graphical relationship between inverses.

Priority Standards

- **AII.ASE.2:** Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- **AII.PR.3:** Solve real-world and other mathematical problems involving **radical** and rational equations. Give examples showing how extraneous solutions may arise.

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^(1/3) is defined 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.)
- **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.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.

Enduring Understandings

- Some solutions to radical equations may be extraneous and therefore are invalid solutions to the equation.
- Rational exponents are another way to represent radicals, where the index of the radical is the denominator of the exponent.
- 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.
- The graph of an inverse function is a reflection of the original function over the line $y = x$.

Essential Questions

- Is it possible to identify a radical equation as having no real roots just by looking at it? Why or why not?
- Do you prefer to use rational exponent notation or radical notation? Why?
- What is a real-world situation that can be modeled by a function where the inverse function would also be meaningful?
- How can an understanding of the graphing relationship between a function and its inverse aid in graphing new parent functions?

Key Concepts

- 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)

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)

Vocabulary

- Asymptote
- Composition of functions
- Dependent variable
- Domain
- End behavior
- Exponent
- Exponential expression
- Extraneous solution

• 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 radical functions. (AII.PR.3) • I can identify and understand extraneous solutions and the situations in which they arise. (AII.PR.3)	• 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) • 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 graph square root 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)	• Function • Horizontal line test • Independent variable • Integer • Intercept • Inverse function • Inverse relationship • Line of symmetry • One-to-one • Power of a power • Power of a product • Power of a quotient • Product of powers • Properties of exponents • Quotient of powers • Radical • Radical expression • Radical function • Range • Rational number • Reflection • Square-root function

Mathematical Processes

- PS.2 Reason abstractly and quantitatively.
- PS.6 Attend to precision.

Resources

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

School Resources	
Textbook Module 6: Inverses and Radical Functions 6.1 Operations on Functions (Function Compositions): AII.F.1 6.2 Inverse Relations and Functions: AII.F.2, AII.F.3 6.3 nth Roots and Rational Exponents: AII.ASE.1, AII.ASE.2, AII.PR.3 6.4 Graphing Radical Functions: AII.F.4, AII.PR.2, AII.PR.3 6.5 Operations with Radical Expressions: AII.ASE.1, AII.ASE.2, AII.PR.3 6.6 Solving Radical Equations: AII.ASE.1, AII.ASE.2, AII.PR.2, AII.PR.3	**Formative Assessments**

General Description of the Unit

In this unit, students will build on their competency with exponential relationships by identifying an exponential relationship, finding the rate of change and classifying it as growth or decay, and simplifying exponential expressions. Then they solve exponential equations and graph exponential functions with and without technology. Finally, bivariate data is modeled with linear, quadratic, and exponential functions.

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.
- **AII.EL.5:** Solve **exponential** and logarithmic equations in one variable.
- **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.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, k f(x), f(kx), or f(x + k).

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.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 describe a common ratio at which variables change. This ratio results in either growth or decay.
- Exponential functions can be graphed by applying transformations; sometimes the equation will first need to be rearranged using the properties of exponents.
- 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.

Essential Questions

- What are key features of an exponential equation that help reveal a path for solving it?
- How does the change in a linear function differ from that in an exponential function? How is it similar?
- Do exponential functions have a single parent function? Why or why not?
- What features of a bivariate data set should be considered to select the best function-type to use a model?

Key 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 graph exponential functions with technology. (AII.EL.1)
- I can graph exponential 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)

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 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)

Vocabulary

- Asymptote
- Bivariate data
- Correlation coefficient
- Decay rate
- Domain
- End behavior
- Exponential decay
- Exponential equation
- Exponential function
- Exponential growth
- Factor
- Growth rate
- Horizontal shift
- Horizontal stretch
- Initial value
- Intercepts
- Inverse
- Linear function
- Parent function
- Percent rate of change
- Properties of exponents

• I can solve exponential equations in one variable. (AII.EL.5) • 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)	• I can solve real-world exponential equations using technology. (AII.EL.6) • I can interpret my solution to an exponential equation and determine the reasonableness of it. (AII.EL.6) •	• Quadratic function • Range • Reflection • Solution • Transformation • Vertical shift • Vertical stretch

Mathematical Processes

- PS.3 Construct convincing arguments and critique the reasoning of others.
- PS.4 Model with mathematics.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.DSP.3 • AII.EL.1 • AII.EL.5 • AII.F.4	• IDOE Examples/Tasks AII.DSP.3 • IDOE Examples/Tasks AII.EL.1 • IDOE Examples/Tasks AII.EL.5 • IDOE Examples/Tasks AII.F.4 • IDOE Examples/Tasks AII.EL.2 • IDOE Examples/Tasks AII.EL.3 • IDOE Examples/Tasks AII.EL.6	• Curve Fitting • Graph Paper • Graphing Calculator • Line of Best Fit • Scientific Calculator • Univariate Data Displays • Virtual Graph Paper

School Resources

Textbook	Formative Assessments
Module 7: Exponential Functions 7.1 Graphing Exponential Functions: AII.F.4, AII.EL.1, AII.EL.2, AII.DSP.3 7.2 Solving Exponential Equations and Inequalities (SKIP Inequalities): AII.EL.5 7.3 Special Exponential Functions: AII.EL.1, AII.EL.3 7.4 Geometric Sequences and Series (SKIP) 7.5 Modeling Data: AII.DSP.3	

General Description of the Unit

Now the concept of a logarithm is introduced, and the properties of exponents are extended to simplify logarithmic expressions. Then they solve logarithmic equations and graph logarithmic functions with and without technology; this includes using transformations when appropriate, identifying key features, and recognizing the inverse relationship between exponential and logarithmic functions. Finally, students will solve real-world situations that can be modeled with exponential and logarithmic functions.

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.
- **AII.EL.5:** Solve exponential and **logarithmic** equations in one variable.

Supporting Standards

- **AII.EL.4:** Use the properties of exponents to derive the properties of logarithms. Evaluate exponential and logarithmic expressions.
- **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.

Essential Questions

- How are exponential functions and logarithmic functions related?
- Why are logarithms important?

Key Concepts

- 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 logarithmic functions such as intercepts, domain and range, and asymptotic and end behavior. (AII.EL.1)
- I can solve logarithmic equations in one variable. (AII.EL.5)

Related Concepts

- I can use the properties of exponents to derive the properties of logarithms. (AII.EL.4)
- I can evaluate exponential expressions. (AII.EL.4)
- I can evaluate logarithmic expressions. (AII.EL.4)
- I can represent real-world problems using logarithmic functions in one variable. (AII.EL.6)
- I can solve real-world logarithmic equations using technology. (AII.EL.6)
- I can interpret my solution to a logarithmic equation and determine the reasonableness of it. (AII.EL.6)

Vocabulary

- Asymptote
- Domain
- End behavior
- Initial value
- Intercepts
- Inverse
- Logarithmic equation
- Logarithmic expression
- Logarithmic function
- Properties of exponents
- Properties of logarithms
- Range
- Solution

Mathematical Processes

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

Resources

Proficiency Scales

- AII.EL.1
- AII.EL.5

Digital

- IDOE Examples/Tasks AII.EL.1
- IDOE Examples/Tasks AII.EL.5
- IDOE Examples/Tasks AII.EL.4
- IDOE Examples/Tasks AII.EL.6

Manipulatives

- Graph Paper
- Graphing Calculator
- Scientific Calculator
- Virtual Graph Paper

School Resources	
Textbook Module 8: Logarithmic Functions 8.1 Logarithms and Logarithmic Functions: AII.EL.1, AII.EL.4, AII.EL.6 8.2 Properties of Logarithms: AII.EL.4, AII.EL.5, AII.EL.6 8.3 Common Logarithms: AII.EL.5, AII.EL.6 8.4 Natural Logarithms: AII.EL.5, AII.EL.6 8.5 Using Exponential and Logarithmic Functions: AII.EL.5, AII.EL.6	**Formative Assessments**

General Description of the Unit

This unit focuses on solving and graphing rational equations; solving equations should include an exploration into extraneous solutions. Additionally, students will write and solve rational equations that model a real-world situation. Finally, students will graph rational equations using technology and will identify key features.

Notes: Section 9.5 is an optional section; direct and indirect variation are the only topics that need to be considered. Section 9.6 only needs to include rational equations and does not need to include rational inequalities. All graphing can be done with technology.

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

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.

Enduring Understandings

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

Essential Questions

- How do I know when a rational function is simplified?
- Are there any characteristics that all rational functions will share? Why or why not?
- Is it possible to identify a rational 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 solve real-world problems involving rational 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)

Related 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)

Vocabulary

- Absolute value function
- Algebraic rational expression
- Asymptote
- Common denominator
- Domain
- End behavior
- Extraneous solution
- Intercept
- Line of symmetry
- Piecewise function
- Polynomial function
- Properties of exponents
- Range
- Rational function
- Rational numbers
- Square-root function

Mathematical Processes

- PS.1 Make sense of problems and persevere in solving them.
- PS.7 Look for and make use of structure.

Resources

Proficiency Scales	Digital	Manipulatives
• AII.ASE.3 • AII.PR.3	• IDOE Examples/Tasks AII.ASE.3 • IDOE Examples/Tasks AII.PR.3 • IDOE Examples/Tasks AII.PR.2	• Graph Paper • Graphing Calculator • Scientific Calculator • Virtual Graph Paper

School Resources

Textbook	Formative Assessments
Module 9: Rational Functions 9.1 Multiplying and Dividing Rational Expressions: AII.ASE.3 9.2 Adding and Subtracting Rational Expressions: AII.ASE.3 9.3 Graphing Reciprocal Functions: AII.PR.2 9.4 Graphing Rational Functions: AII.PR.2 9.5 Variation: AII.PR.2 (Optional) 9.6 Solving Rational Equations and Inequalities (SKIP Inequalities): AII.PR.3	

General Description of the Unit

In this unit, students work with statistics involving both univariate and bivariate data, two topics with which students have had extensive exposure in past courses. For univariate data, the key new topics for students are standard deviation and variance. The other analysis tools (measures of center, range, inter-quartile range, outliers) have been taught in previous grades. Students will also explore best practices in statistics and will apply these practices to design experiments.

For probability, 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. Finally, students will compare theoretical models with the results of a simulation.

Priority Standards

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

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

Enduring Understandings

- Analyzing the spread, center, and outliers of data along with graphical displays gives a statistical summary of the data set.
- 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.
- It is important to have well designed experiments; sampling methods, survey questions, and experiment protocols all need to be considered.
- 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.
- 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

- Why is it important to be able to represent data using graphs and measures of central tendency?
- How are measures of central tendency different from standard deviation?
- 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?
- In an excellent simulation, will the theoretical probability and experimental probability be the same? Why or why not?

Key Concepts	Related Concepts	Vocabulary

• 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)	• 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 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) • 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) • 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)	• Bias • Combination • Conditional probability • Dependent event • Empirical model • Experiment • Factorial • Fundamental Counting Principle • Independent event • Inference • Interquartile range (IQR) • Law of Large Numbers • Mean • Median • Non Random sampling • Outlier • Permutation • Random sampling • Range • Simulation • Standard deviation • Survey • Theoretical model • Univariate data • Variance
Mathematical Processes • PS.2 Reason abstractly and quantitatively.		

- PS.3 Construct convincing arguments and critique the reasoning of others.

Resources		
Proficiency Scales	**Digital**	**Manipulatives**
• AII.DSP.6	• IDOE Examples/Tasks AII.DSP.6 • IDOE Examples/Tasks AII.DSP.1 • IDOE Examples/Tasks AII.DSP.2 • IDOE Examples/Tasks AII.DSP.4 • IDOE Examples/Tasks AII.DSP.5	• Graph Paper • Scientific Calculator • Spinner • Univariate Data Displays • Virtual Graph Paper

School Resources	
Textbook	**Formative Assessments**
Module 10: Inferential Statistics 10.1 Random Sampling: AII.DSP.1 10.2 Using Statistical Experiments: AII.DSP.4 Supplement: Probability DSP.5 and DSP.6 10.3 Analyzing Population data: AII.DSP.2 10.4 Normal Distributions: AII.DSP.2 10.5 Estimating Population Parameters: AII.DSP.1	