Applications of Math 9

	Key Standards Covered	Possible Resources

Quarter 1 September 6- November 2	• CCSS.MATH.CONTENT.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • CCSS.MATH.CONTENT.HSA.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). • HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). • HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* • HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* • HSF.IF.C.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima. • HSF.LE.B.5: Interpret the parameters in a linear or	• AIT Project #1- Coordinate Plane String Art: Students will choose one of 15 designs, then given a cardstock square that has a 4-quadrant coordinate plane on the back; they will follow the sets of ordered pairs, sewing through each plotted point in order to create elaborate string art. • https://d3jc3ahdjad7x7.cloudfront.net/DlFncUvTNcS8RpquyagOjyoymt31dVVyFETqwfmISGkCv7we.pdf • AIT Project #2- Stained Glass Graphing: Students will practice graphing lines in slope-intercept form. They first must make sure the given equations are in the correct form then graph each linear equation. They will be graphing lines with positive, negative, zero, and undefined slopes. When completed, the correctly graphed lines will created a unique pattern that they will then use (markers/pencils/paint/tissue paper etc.) to have the finished product of their "stained glass window" . • https://vickimasseywordpress.files.wordpress.com/2017/03/8-stained-glass-

	Key Standards Covered	Possible Resources

Quarter 2 November 12- January 28	• CCSS.MATH.CONTENT.HSA.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. • CCSS.MATH.CONTENT.HSA.REI.D.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). • HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). • HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* • HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* • HSF.IF.C.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima. • HSF.LE.B.5: Interpret the parameters in a linear or	• AIT Project #1- Coordinate Plane String Art: Students will choose one of 15 designs, then given a cardstock square that has a 4-quadrant coordinate plane on the back; they will follow the sets of ordered pairs, sewing through each plotted point in order to create elaborate string art. • https://d3jc3ahdjad7x7.cloudfront.net/DlFncUvTNcS8RpquyagOjyoymt31dVVyFETqwfmISGkCv7we.pdf • AIT Project #2- Stained Glass Graphing: Students will practice graphing lines in slope-intercept form. They first must make sure the given equations are in the correct form then graph each linear equation. They will be graphing lines with positive, negative, zero, and undefined slopes. When completed, the correctly graphed lines will created a unique pattern that they will then use (markers/pencils/paint/tissue paper etc.) to have the finished product of their "stained glass window" . • https://vickimasseywordpress.files.wordpress.com/2017/03/8-stained-glass-

	Key Standards Covered	Possible Resources

Quarter 3
February 4- April 5
	• CCSS.MATH.CONTENT.HSN.RN.A.1
	  • Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
	• CCSS.MATH.CONTENT.HSN.RN.A.2
	Rewrite expressions involving radicals and rational exponents using the properties of exponents
	• CCSS.MATH.CONTENT.HSN.RN.B.3
	  • Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number.
	• CCSS.MATH.CONTENT.HSA.APR.A.1
	  • Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
	• CCSS.MATH.CONTENT.HSA.APR.B.2
	  • Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
	• CCSS.MATH.CONTENT.HSA.APR.B.3
	  • Identify zeros of polynomials when suitable
		• AIT Project #1 - Laws of Exponents Foldable Study Guide : Students will construct a foldable flipbook to use a study guide and learning manipulative for the rules and laws of exponents.
		• AIT Project #2 - The Size of our Solar System: Students will create a scaled model of our solar system out of their choice of materials. They must include the planets measurements and distances all using scientific notation. They will be given conversions and other reference materials from the NasaMath workbook to complete this task.
		• Working with scientific notation, students will solve problems about mass and percentages.

	Key Standards Covered	Possible Resources

Quarter 4
April 8- June 17
	• CCSS.MATH.CONTENT.HSN.RN.A.1
	  • Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
	• CCSS.MATH.CONTENT.HSN.RN.A.2
	Rewrite expressions involving radicals and rational exponents using the properties of exponents
	• CCSS.MATH.CONTENT.HSN.RN.B.3
	  • Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number.
	• CCSS.MATH.CONTENT.HSA.APR.A.1
	  • Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
	• CCSS.MATH.CONTENT.HSA.APR.B.2
	  • Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
	• CCSS.MATH.CONTENT.HSA.APR.B.3
	  • Identify zeros of polynomials when suitable
		• AIT Project #1 - Laws of Exponents Foldable Study Guide : Students will construct a foldable flipbook to use a study guide and learning manipulative for the rules and laws of exponents.
		• AIT Project #2 - The Size of our Solar System: Students will create a scaled model of our solar system out of their choice of materials. They must include the planets measurements and distances all using scientific notation. They will be given conversions and other reference materials from the NasaMath workbook to complete this task.
		• Working with scientific notation, students will solve problems about mass and percentages.

Applications of Mathematics 9: Unit 1

Expressions, Functions, & Number Systems

Title of Unit	Expressions, Functions, & Number Systems	**Grade Level**	9
Curriculum Area	Applications of Mathematics 9	**Time Frame**	46 Class Periods
Developed By	Erica Mazza		
Identify Desired Results (Stage 1)			
Content Standards			

CCSS.MATH.CONTENT.HSA.CED.A.2:
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.MATH.CONTENT.HSA.REI.D.10:
Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

HSF.IF.A.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

HSF.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

HSF.IF.B.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*
- HSF.IF.C.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.
- HSF.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.

Understandings	**Essential Questions**	
Overarching Understanding	**Overarching**	**Topical**

• Students will use variables in algebraic manipulations that reflect mathematical relationships to interpret, predict, and solve real-world problems. • Students will recognize the fluid relationships between fractions, decimals, and percents. • Many universal relationships can be expressed mathematically to assist in predicting outcomes and solving problems. • Using graphs to represent and interpret data provides for greater understanding and communication. • Equations can be used to represent relationships and by solving for "x" and "y" variables. • Understanding intercept equations provides additional facility with relationships. • Understanding the true meaning of a y-intercept and the slope of a line. • Know that there are many methods available for them to mentally and physically manipulate numerical values. • Students will understand how to use fundamental math operations to solve equations to find the exact answer. • Students will be able to discuss, interpret, predict, and solve word problems. • Students understand the value of quantitative reasoning skills for a variety of real world applications.	How are variables used to understand and solve real world problems? How does numerical understanding and facility provides greater access for advancement in all career areas? How are relationships expressed numerically and graphically? How do equations assist us in expanding our knowledge of relationships? How can graphical interpretations assist understanding and expand communications? What is the value of correlating data in the real world? What are the various ways relationships and functions can be graphed?	How can patterns in representation of numerical and variable quantities be useful? Why are there different forms of linear equations? How can the y-intercept equation be used to predict graphical data and find additional relationships? What is the significance of the slope of a line? How do specific equations relate to the world we live in? How do you derive equations from different sets of data? How do we use equations to help us decipher quantitative relationships?
Related Misconceptions		

• Equality Symbol Misconceptions • Concept of a Variable Misconceptions. • How to handle basic arithmetic skills involving negative numbers. • Graphing Misconception – Students having trouble remembering which axis is which to be able to graph points and lines correctly. • How to use the different linear equations forms (slope-intercept, Standard, Point-Slope) to correctly graph a line. • Confusing whether to add or subtract across the equal sign to combine like terms.	How do graphing calculations enhance your ability to graph? Why do we need to understand basic math facts to solve equations? How does solving equations relate to problems in the real world?	
Knowledge Students will know…	**Skills** Students will be able to…	

● That variables can represent a variety of different quantities that can be manipulated mathematically. ● The order of operations and how to use them when given more complex algebraic equations. ● That unit analysis can be used to evaluate problems involving rates of change. ● That the evaluation and comparison of real numbers can be used to make predictions and influence decision making. ● How to manipulate data within equations, graphs, and charts or tables. ● How to use key equations and graphs to manipulate data and relationships. ● How to interpret graphs to answer a variety of questions about related data.	1. Examine order of operations through addition, subtraction, multiplication, and division of integers and rational numbers. 2. Analyze number relationships by creating equivalent fractions, comparing fractions, decimals, percents, and numbers on a number line. 3. Simplify expressions using distributive property and by combining like-terms. 4. Justify why we use substitution and order of operations to evaluate functions and expressions. 5. Translate written words into algebraic sentences. 6. Graph linear equations given data in any form. 7. Create a linear or quadratic equation from data given in any form. 8. Create various graph types, given statistical data 9. Interpret and compare graphs. 12. Solve multi-step equations 13. Solve equations with variables on both sides 14. Solve equations with fractions, decimals and exponents. 15. Solve proportion problems. 16. Create equations and solve problems from word problems including those involving linear systems. 17. Analyze word problems and performance tasks 18. Extract words that represent different mathematical operations 19. Create linear equations to model and solve real world problems.

Assessment Evidence (Stage 2)

Performance Task Description

• **Goal** • **Role** • **Audience** • **Situation** • **Product/ Performance** • **Standards**	**AIT Project #1- Coordinate Plane String Art:** Students will choose one of 15 designs, then given a cardstock square that has a 4-quadrant coordinate plane on the back; they will follow the sets of ordered pairs, sewing through each plotted point in order to create elaborate string art. https://d3jc3ahdjad7x7.cloudfront.net/DlFncUvTNcS8RpquyagOjyoymt31dVVyFETqwfmISGkCv7we.pdf **AIT Project #2- Stained Glass Graphing:** Students will practice graphing lines in slope-intercept form. They first must make sure the given equations are in the correct form then graph each linear equation. They will be graphing lines with positive, negative, zero, and undefined slopes. When completed, the correctly graphed lines will created a unique pattern that they will then use (markers/pencils/paint/tissue paper etc.) to have the finished product of their "stained glass window" . https://vickimasseywordpress.files.wordpress.com/2017/03/8-stained-glass-project.pdf

Other Evidence

Formative: You are planning a party and have narrowed it down to two different venues. Which one offers you the better deal? Calculate your cost based on the venue and the possible number of people. Write and graph an equation to represent this relation

Summative: Marta is selling soup at a farmers market. Based on a survey, what soup should she pick? You will account for materials to help Marta maximize profits.

Learning Plan (Stage 3)

• **Where are your students headed? Where have they been? How will you make sure the students know where they are going?** • **How will you hook students at the beginning of the unit?** • **What events will help students experience and explore the big idea and questions in the unit? How will you equip them with needed skills and knowledge?** • **How will you cause students to reflect and rethink? How will you guide them in rehearsing, revising, and refining their work?** • **How will you help students to exhibit and self-evaluate their growing skills, knowledge, and understanding throughout the unit?** • **How will you tailor and otherwise personalize the learning plan to optimize the engagement and effectiveness of ALL students, without compromising the goals of the unit?** • **How will you organize and sequence the learning activities to optimize the engagement and achievement of ALL students?**		**Hook: Intro Video from Disney/Khan Academy** MAKING MATH COOL: Learning the Equations behind Pixar Movies Kids can see how Disney artists use everyday math concepts they learned in school to create movies. https://letslassothemoon.com/2015/09/09/equations-behind-pixar-movies/ Lesson 1-1: Variables and Expressions " (Pg. 7: 34) Lesson 1-2: Order of Operations (Pg. 13: 38) Lesson 1-3: Properties of Numbers: Problem Solving: "Precision" (Pg. 20: 50) Lesson 1-4: The Distributive Property: Problem Solving : "Reasoning" (Pg. 29: 12) Lesson 1-5: Equations: Problem Solving: "Sense-Making" (Pg. 37: 47) Lesson 1-6: Relations: Problem Solving: "Modeling" (Pg. 43: 17-18) Lesson 1-7: Functions : Check Understanding: "Reasoning" (Pg. 51: 10) Graphing Technology Lab: Representing Functions (Pg. 55) Lesson 1-8: Interpreting Graphs of Functions: Problem Solving: "Sense-Making" (Pg. 59: 1-9) Lesson 5-1: Solving Inequalities by Addition and Subtraction CCSS: Problem Solving: "Reasoning" (Pg. 289: 46-51) Lesson 5-2: Solving Inequalities by Multiplication and Division https://d3jc3ahdjad7x7.cloudfront.net/DlFncUvTNcS8RpquyagOjyoymt31dVVyFETqwfmISGkCv7we.pdf https://vickimasseywordpress.files.wordpress.com/2017/03/8-stained-glass-project.pdf

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Applications of Mathematics 9: Unit 2
Exponents, Roots, and Polynomials

Title of Unit	Exponents, Roots and Polynomials	**Grade Level**	9
Curriculum Area	Applications of Mathematics 9	**Time Frame**	46 Class Periods
Developed By	Erica Mazza		
Identify Desired Results (Stage 1)			
Content Standards			

CCSS.MATH.CONTENT.HSN.RN.A.1

Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

CCSS.MATH.CONTENT.HSN.RN.A.2

Rewrite expressions involving radicals and rational exponents using the properties of exponents

CCSS.MATH.CONTENT.HSN.RN.B.3

Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number.

CCSS.MATH.CONTENT.HSA.APR.A.1

Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

CCSS.MATH.CONTENT.HSA.APR.B.2

Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x - a is p(a), so p(a) = 0 if and only if (x - a) is a factor of p(x).

CCSS.MATH.CONTENT.HSA.APR.B.3

Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

CCSS.MATH.CONTENT.HSA.APR.C.4

Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

CCSS.MATH.CONTENT.HSA.APR.C.5

(+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of xand y for a positive integer n,

<table>
<tr><th colspan="2">Understandings</th><th colspan="2">Essential Questions</th></tr>
<tr><td colspan="2">Overarching Understanding</td><td>Overarching</td><td>Topical</td></tr>
<tr><td colspan="2">● Exponents provide expedient methods to working with very large or very small values and are equal in value.
● Exponents behave just like any other number; they can undergo any mathematical function.
● Polynomials can be classified to assist in problem solving strategies.
● Calculations with polynomials require combining like terms and then using
● basic mathematics to add, subtract, multiply and divide (factoring).
● Understand the relationship between an equation and the product of its
● roots.
● How to represent irrational numbers and where they appear in the real world.</td><td rowspan="3">● How are exponents used in the real world and why are they important?
● How are exponents used in scientific notation and why is it important?
● How can the use of exponents make mathematical calculations easier?
● How can pattern recognition assist you in solving equations that include polynomials?
● Why are algebraic operations with polynomials important?</td><td rowspan="3">● How are positive and negative exponents related to actual numerical values?
● How are exponential values manipulated (addition, subtraction, multiplication, division,
● raised to another power).
● What is the meaning of an equation containing an exponent?
● What is the value of scientific notation?
● How are polynomials manipulated in solving equations?
● How are irrational numbers represented and where do they appear in the real world?
● How do you recognize how to factor a polynomial?</td></tr>
<tr><td colspan="2">Related Misconceptions</td></tr>
<tr><td colspan="2">● Equality to values Misconceptions
● Concept of a Variable Misconceptions
● Variables with different exponents can’t be added.
● When raising a variable or a number to an exponent versus multiplying an
● expression.</td></tr>
<tr><td colspan="2">Knowledge
Students will know…</td><td colspan="2">Skills
Students will be able to…</td></tr>
</table>

• How exponents and roots are related • How rational and irrational numbers are related • That values translated into exponential notation can save them time and prevent errors. • Exponents can easily be manipulated by using the same mathematical functions they have always used (addition, subtraction, multiplication, division). • How and when to use the Pythagorean theorem to find the missing side of a triangle • How to find the distance and/or midpoint between two ordered pairs using a formula • When scientific notation is an appropriate form to represent numbers • How scientific notation is related to standard form of a number • How the distributive property can be used with polynomials. • How keeping track of positive and negative values within • polynomial manipulations will help avoid calculation errors • How identifying and combining like terms can simplify problem solving with • polynomials. • How to simplify square roots and polynomial expressions. • How to solve polynomial equations by factoring (greatest common factor).	- • Identify perfect squares • Find the square root of a number • Evaluate radical expressions using order of operations translate values to and from exponential • manipulate exponents in equations through various methods. • Simplify exponents • Simplify, add, subtract, multiply and divide square roots. • Evaluate and estimate square roots. • Change between scientific notation and standard form • Order and compare numbers in scientific notation • Perform operations with numbers in scientific notation (using a calculator) • Use scientific notation to represent actual • measurements (• Students will use scientific notation in real-life situations. • Add, subtract, and multiply polynomials. • Multiply a binomial by a monomial, binomial or trinomial. • Factor polynomials. • Use factoring in special cases. • Using patterns to find binomial squared. • Using FOIL to multiply 2 binomials.

Assessment Evidence (Stage 2)

Performance Task Description

• **Goal** • **Role** • **Audience** • **Situation** • **Product/Performance** • **Standards**	• **AIT Project #1** - Laws of Exponents Foldable Study Guide : Students will construct a foldable flipbook to use a study guide and learning manipulative for the rules and laws of exponents. • **AIT Project #2** - The Size of our Solar System: Students will create a scaled model of our solar system out of their choice of materials. They must include the planets measurements and distances all using scientific notation. They will be given conversions and other reference materials from the NasaMath workbook to complete this task.

Other Evidence

Working with scientific notation, students will solve problems about mass and percentages.

Learning Plan (Stage 3)

• **Where are your students headed? Where have they been? How will you make sure the students know where they are going?** • **How will you hook students at the beginning of the unit?** • **What events will help students experience and explore the big idea and questions in the unit? How will you equip them with needed skills and knowledge?** • **How will you cause students to reflect and rethink? How will you guide them in rehearsing, revising, and refining their work?** • **How will you help students to exhibit and self-evaluate their growing skills, knowledge, and understanding throughout the unit?** • **How will you tailor and otherwise personalize the learning plan to optimize the engagement and effectiveness of ALL students, without compromising the goals of the unit?** • **How will you organize and sequence the learning activities to optimize the engagement and achievement of ALL students?**	Lesson 7-1: Multiplication Properties of Exponents CCSS: Problem Solving: "Tools" (Pg. 395: 58-60) Lesson 7-2: Division Properties of Exponents CCSS: Problem Solving: "Sense-Making" (Pg. 403: 57) Lesson 7-3: Rational Exponents CCSS: Higher-Order Thinking Problem: "Arguments" (Pg. 412: 90) Lesson 7-4: Scientific Notation CCSS: Problem Solving: "Modeling" (Pg. 418: 66) Graphing Technology Lab: Family of Exponential Functions (Pg. 422) Lesson 7-5: Exponential Functions CCSS: Problem Solving: "Modeling" (Pg. 427: 20) Graphing Technology Lab: Solving Exponential Equations and Inequalities (Pg. 430) Lesson 7-6: Growth and Decay CCSS: Problem Solving: "Precision" (Pg. 434: 9) Lesson 7-7: Geometric Sequences as Exponential Functions CCSS: Problem Solving: "Reasoning" (Pg. 441: 32) Lesson 7-8: Recursive Formulas CCSS: Higher-Order Thinking Problem: "Modeling" (Pg. 448: 22) Laws of Exponents https://drive.google.com/open?id=0B4LG0vMBCptgYVNhUWViMlFFRlE Applying Equations to meaurement: Exponential Distance https://www.nasa.gov/pdf/622145main_SSML1Answr.pdf **<u>Strategies for differentiation: Mastery of concepts for ALL students</u>** • Pretest students to assess key pre-skills and background knowledge • Using compacting strategy to account for prior student mastery of objectives • Provide grouping by difficulty level, with varying levels of support (Tiering) • Provide different demonstrations or models • Offer choice of response (verbal, using numerical representations, creating a

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