Algebra3/Trigonometry

Elective

Sayreville War Memorial High School

5 Credits

Full Year

Date Curriculum Approved/ Revised: R. Abadir & S. Magaw 2018

Table of Contents:

Summary of the Course

This course begins with an introduction to basic Algebraic concepts and an in-depth study of varies functions and their properties and graphs. Real world problem solving are fundamental bearings of the course. The idea of trigonometric functions and identities are stressed. In addition, students will explore concepts related to statistics and probability.

In order to prepare for global competition and high expectations for all, Sayreville War Memorial HS students must have increased opportunities for mathematical experiences that extend critical thinking and reasoning. Specifically, access to higher mathematics is essential. Algebra III/ Trigonometry is a course intended for students who have completed any level of Algebra 2. This course is recommended for juniors who wish to take Pre-Calculus during their senior year and for college-bound seniors who desire to strengthen their essential algebra skills and basic Trigonometry. This course will enhance the higher-level thinking skills developed in Algebra 2 through a more in-depth study of those concepts and exploration of some Pre-Calculus and Statistics concepts.

In order to demonstrate a cohesive and complete implementation plan the following general suggestions are provided:

- The use of various formative assessments are encouraged in order to provide an ongoing method of determining the current level of understanding the students have of the material presented.

- Homework, when assigned should be relevant and reflective of the current teaching taking place in the classroom.
- Organizational strategies should be in place that allow the students the ability to take the information gained in the classroom and put in in terms that are relevant to them.
- Instruction should be differentiated to allow students the best opportunity to learn.
- Assessments should be varied and assess topics of instruction delivered in class.
- Modifications to the curriculum should be included that address students with Individualized Educational Plans (IEP), English Language Learners (ELL), and those requiring other modifications (504 plans).

Unit 1: Linear Relations and Functions

Summary of the Unit:

In this unit, students will be able to analyze graphs of relations and functions, determine if relations are functions, use function notation, and write and graph linear equations. Students will be able to find and interpret the meaning of the slope of a line in order to solve real-world problems. Students will be able to make connections between the study of linear functions and real world word problems situations.

Enduring Understanding: Relations and functions can be represented numerically, graphically, algebraically, and/or verbally. Functions can be identified using a variety of techniques, including the Vertical Line Test. There are many forms of linear equations, and the most useful form depends on what you are trying to accomplish (i.e., graph, or find intercepts). The slope of a line indicate the rate of change of vertical units over horizontal units.

Essential Questions:

What are the important defining characteristics and representations of a function?
How do you find the slope of a line and use it to write an equation of the line?
How is the graph of a function used to determine the key elements of that function?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.

Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:

Worksheets, Online assignments, and Textbook
Websites may be used https://www.math-drills.com/
https://www.education.com/worksheets/math/
https://www.kutasoftware.com/
https://www.khanacademy.org/math

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards
Relations and Functions	2 days	Analyze graphs of relations and functions.	• Present relations and functions in multiple	Check student responses.	MA.9-12.F-IF.A.1 MA.9-12.F-IF.A.2 MA.9-12.F-IF.A.3

		Determine if a relation is a function.	representations, and use the definition of function or Vertical Line Test to determine if a relation is a function. • Introduce function notation and how to use it. Indicate that *f(x)* is not the only way to write function notation (i.e. *g(a), C(d), A(r)*) and that *f(x) means y.*	Assess understanding via oral participation. Circulate to check student work. Classwork assigned. Homework assigned. Use Q & A for Closure. Exit cards.	
Slope	2 days	Find and use the slope of a line given linear equation, graph, or points on the graph. Recognize and convert equation to	• Encourage students to recall slope formula, and slope and y-intercept form of linear equation. • Enhance		MA.9-12.A-REI.D.10 MA.9-12.F-IF.B.4 MA.9-12.F-IF.B.6

		slope and y-intercept form.	student's understanding of slope by Indicating that slope is a rate of change.		
Standard form of linear equations	2 days	Recognize and convert linear equation to standard form.	• Model writing linear equations in standard form.		MA.9-12.A-REI.A
Graphing linear equations and functions	2 days	Graph a linear function using intercepts. Determine if two lines are parallel, perpendicular, or neither. Graph parallel and perpendicular lines.	• Graph a linear equation using the intercepts method. • Discuss what makes lines parallel, perpendicular, or neither. • Use knowledge of parallel and perpendicular		MA.9-12.A-REI.D.10 MA.9-12.A-REI.D.11 MA.9-12.F-IF.B.4

			lines to graph		
Writing linear equations	3 days	Write equations of lines given a slope and *y*-intercept, a point and a slope, or two points.	• Provide students with examples of each type of problem, and tips on where to start. • Have students practice in small groups.		MA.9-12.A-CED
Applications on linear functions	2 days	Recognize and solve word problems that deal with supply and demand, and cost functions. Recognize and solve problems that deal with direct and inverse variation.	• Model several problems on each type and relate each word problem situation to linear functions. • Help students make connections to real world situations.		MA.9-12.A-CED
Suggested Modifications for Special Education, English Language Learners and Gifted Students: *Consistent with individual plans, when appropriate. Such as using google translate, and or Implement 504 and special modifications listed on student's IEP.					

Suggested Technological Innovations/ Use:

Instructional technology should be used to present and assess lessons such as; SmartNotebook, PowerPoint, graphing calculators, Communicators/individual dry erase boards.

Teachers are encouraged to use electronic assessments to determine mastery of concepts taught.

The use of kahoot or other types of interactive software is encouraged.

Cross Curricular/ 21st Century Connections:

9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.

9.2 21st Century Life and Career Skills: All students will be able to identify the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Unit 2: Systems of Equations and Inequalities

Summary of the Unit: In this unit, students will be able to solve systems of linear equations graphically or algebraically and interpret the meaning of the point of intersection. Students will extend their study to include the finding the point of intersection of three planes as well as solving linear programing problems.

Enduring Understanding: The solution to a linear system of equations represents the point of intersection of the two lines and has meaning based on the context of the original question. Graphing can be used to identify optimal solution to real world word problem by applying linear programming concept.

Essential Questions:
How do you use substitution and graphing to solve systems of equations?
How do you use elimination to solve systems of equations?
How do you solve systems of linear equations in more than two variables?
What process would you use to optimize the objective function?
What is the feasible region, and how does it contribute to identifying solutions to a problem?
How might the number of constraints affect possible solutions?
How would you apply what you have learned in systems of inequalities to linear programming?
What are some real-world situations that can be solved using linear programming?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
Worksheets, Online assignments, and Textbook
Websites may be used https://www.math-drills.com/
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https://www.kutasoftware.com/
https://www.khanacademy.org/math

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards

Systems of Two Linear Equations and Inequalities in Two Variables	5 days	Given a system of linear equations in two variables, approximate solutions graphically and confirm algebraically. Solve systems by substitution or elimination. Graph a system of linear inequalities (determine whether the line is dashed or solid, and shade the correct half-planes lightly, and shade the solution set dark). Solve systems of two equations in two variables that involve word problems.	• Review and reteach the graphing, elimination, and substitution techniques and the importance of the "check" • Demonstrate how to use the graphing calculator to find the solution to a system of equations. • Discuss what "no solution" or "infinitely many" solutions looks like and means. • Relate graphing a system of inequalities back to graphing just one linear inequality. • Demonstrate how to use the graphing	Assess understanding via oral participation. Check student graphs. Circulate to check student work. Check for correct use of graphing calculator. Check translations of word problems into algebra. Classwork assigned. Homework assigned. Use Q & A for Closure. Exit cards.	MA.9-12.A-REI.C.5 MA.9-12.A-REI.C.6 MA.9-12.A-REI.D.10 MA.9-12.A-REI.D.11 MA.9-12.A-REI.D.12

			calculator to confirm the solutions to a system of inequalities. • Provide multiple examples of word problems involving systems, such as number, money, geometry and age problems. Review common errors in translating word problems into algebra.		
Systems of three Linear Equations in three Variables	5 days	Given a system of linear equations in three variables, solve by elimination and check.	• Demonstrate solving systems of three variables by elimination to make it into a system of 2x2 and the back substitute. • Provide time for independent practice in small groups or individually.	Assess understanding via oral participation Circulate to check student work Classwork assigned. Homework assigned. Use Q & A for	MA.9-12.A-REI.C.5 MA.9-12.A-REI.C.6 MA.9-12.A-REI.D.10 MA.9-12.A-REI.D.11 MA.9-12.A-REI.D.12

				Closure. Students craft their very own word problems the require a 3x3 system to be solved, students submit for a grade.	
Linear Programming and Word Problems Applications	5 days	Given a system of inequalities, graph, find vertices of feasible region, and identify maximum or minimum of the objective function. Given a linear programming word problem, students translate into algebra and use graphing technique to find optimal solution.	• Demonstrate and explain graphing systems of inequalities and use feasible region to find max/min of targeted function. • Allow time for independent practice in pairs. • Discuss real world word problems and reaching optimal solution by applying linear programming. • Students practice independently in small groups.	Check student graphs. Circulate to check student work. Classwork assigned. Homework assigned. Use Q & A for Closure.	MA.9-12.A-REI.C.5 MA.9-12.A-REI.C.6 MA.9-12.A-REI.D.10 MA.9-12.A-REI.D.11 MA.9-12.A-REI.D.12
Suggested Modifications for Special Education, English Language Learners and Gifted Students:					

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Suggested Technological Innovations/ Use:

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Teachers are encouraged to use electronic assessments to determine mastery of concepts taught.

The use of kahoot or other types of interactive software is encouraged.

Cross Curricular/ 21st Century Connections:

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Unit 3: Polynomial Expressions and Functions

Summary of the Unit: In this unit, students learn and apply properties of exponents as they simplify expressions involving powers and add, subtract, and multiply polynomials. They learn methods to factor and solve polynomial equations, including the Remainder and Factor Theorems. Using intercepts and other methods, they graph polynomial functions.

Enduring Understanding: Operations may be performed on polynomials. The graph of a polynomial can be used to find real zeros and describe end behavior. Polynomial functions can be evaluated by direct substitution, or by the Remainder Theorem. The Factor Theorem can be used to quickly determine whether a given *x*-value is a zero of the function.

Essential Questions:
How do polynomial functions model real-world problems and their solutions?
How do you use properties of exponents to evaluate and simplify expressions?
How do you evaluate a polynomial function?
How do you graph a polynomial function?
How do you add, subtract, and multiply polynomials?
How do you factor polynomial expressions?
How do you Use factoring to solve polynomial equations?
How do you Divide polynomials and relate the result to the factor theorem?
How do you find the rational zeros of a polynomial function?
How do you Use the fundamental theorem of algebra to determine the number of zeros of a polynomial function?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
Websites may be used https://www.math-drills.com/
https://www.education.com/worksheets/math/
https://www.kutasoftware.com/
https://www.khanacademy.org/math
Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards
Use Properties of Exponents	3 days	Simplify expressions using properties of exponents. As time permits, review scientific notation.	• Review properties of exponents and provide sample problems of increasing level of difficulty. • Include a word problem using scientific notation, as time permits.	Assess student recall of these topics, and review where needed. Check student responses. Classwork assigned. Homework assigned. Closure using Q & A. Exist Cards.	MA.9-12.N-RN.A.1 MA.9-12.N-RN.A.2
Add, Subtract, Multiply & Divide Polynomials	4 days	Add, subtract, and multiply polynomials. Divide polynomials using both long and synthetic division techniques.	• Review how to add, subtract, and multiply polynomials, including special products through example problems. • Demonstrate long division and synthetic division.	Assess student recall of these topics, and review where needed. Check student responses. Monitor student's	MA.9-12.A-APR.A.1 MA.9-12.A-APR.B.2

			• Explain when each division technique can be applicable and the importance of using a place holder. • Discuss what it means to have a remainder in a division problem.	independent work. Classwork assigned. Homework assigned. Closure using Q & A. Exist Cards.	
Apply the Remainder and Factor Theorems	2 days	Evaluate functions using synthetic substitution. Use remainder and factor theorems to identify factors of polynomials.	• Compare traditional substitution and synthetic substitution methods for evaluation functions. • Practice identifying factors of a function by applying remainder factor theorem.	Assess understanding via oral participation Circulate to check student work Monitor student's independent work. Classwork assigned. Homework assigned. Closure using Q & A. Exist Cards.	MA.9-12.A-APR.A.1 MA.9-12.A-APR.B.2

Factor and Solve Polynomial Equations	5 days	Review Factoring techniques Such as greatest common factor, grouping, difference of two squares, sum and difference of two cubes, and factoring trinomials.	• Review all factoring techniques and introduce sum/difference of cubes pattern. • Review Zero Product Property, and its use in solving polynomial equations. • Remind students to "check". • Allow time for independent practice.	Assess student understanding of new factoring pattern. Monitor student's independent work. Classwork assigned. Homework assigned	MA.9-12.A-APR.C.4 MA.9-12.A-REI.A.1 MA.9-12.A-REI.A.2 MA.9-12.A-SSE.B.3a
Sketch Graphs of Polynomial Functions and Analyze End Behavior.	3 days	Use knowledge of x-intercepts and end behavior to sketch graphs of polynomial functions	• Examine given graphs and analyze their end behavior. • Use knowledge of x-intercepts, degree, and leading coefficient to sketch graphs of given functions.	Check student graphs. Circulate to check student work. Classwork assigned.	MA.9-12.A-APR.B.3 MA.9-12.A-REI.D.10 MA.9-12.A-REI.D.11

				Homework assigned. Closure using Q & A. Exist Cards.	

Suggested Modifications for Special Education, English Language Learners and Gifted Students:
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Suggested Technological Innovations/ Use:
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Unit 4: Radical Expressions and Complex Numbers

Summary of the Unit: First, students will learn the meaning of n^{th} roots and rational exponent notation, and how to apply the properties of rational exponents. Next, they will learn to perform operations, including adding, subtracting, multiplying, and dividing radical expressions as well as rationalizing denominators. Then, they will learn how to determine whether a given radical expression has an imaginary unit. Finally, students will learn to simplify and perform operations on complex numbers.

Enduring Understanding: Rational exponents and radical notation can be converted into each other and simplified. Operations, can be performed on Radical expressions and complex numbers.

Essential Questions:
How do you evaluate nth roots of real numbers using both radical notation and rational exponent notation?
How do you use properties of rational exponents to evaluate and simplify expressions?
How do you perform operations with functions including power functions?
How do you find inverses of linear functions?
How do you find inverses of nonlinear functions?
How do you solve equations that contain radicals or rational exponents?
Why do imaginary numbers exist?
How do you add, subtract, and multiply complex numbers?
When does a quadratic equation have imaginary solutions?
How do you find imaginary solutions for quadratic equations?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
Websites may be used https://www.math-drills.com/
https://www.education.com/worksheets/math/
https://www.kutasoftware.com/
https://www.khanacademy.org/math
Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards

Simplify Radical Expressions and Expressions Involving Rational Exponents	4 days	Simplify radical expressions including expressions that involve higher index. Evaluate expressions using rational exponents by converting them into radical form. Use properties of exponents to simplify expressions having rational exponents. Write radicals in simplest form. Add, subtract, multiply and Radicals.	• Provide Instructions on n^{th} roots (different cases based on whether the index is even or odd). • Provide directions how to convert expression using rational exponents to radicals. • Model simplifying these expressions and provide increasingly difficult problems. • Review the idea of "like", and for radicals to be "like", they need the same index and radicand.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned. Homework assigned	MA.9-12.A-APR.D.6 MA.9-12.A-APR.D.7

			• Model adding, subtracting, and multiplying radicals • Allow time for independent practice.		
Rationalizing Denominators	3 days	Write denominators as rational numbers. Write fractions that involve radicals in simplest form.	• Review what rational numbers mean. • Model rationalizing denominators and writing fractions in simplest form. • Use example problems that are varies level of difficulty. • Allow time for independent practice.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned. Homework assigned Exit cards.	MA.9-12.A-APR.D.6
Complex Numbers	5 days	Simplify radical expressions that involve even index and negative radicand.	• Introduce the imaginary unit "i" to Simplify radical expressions that involve even index	Check student understanding via oral participation.	MA.9-12.N-CN.A.1 MA.9-12.N-CN.A.2 MA.9-12.N-CN.A.3

		Add, subtract, multiply, and divide complex numbers.	and negative radicand. • Model adding, subtracting, multiply, and divide complex numbers introducing the idea of conjugates. • Use conjugates to rationalize denominators.	Check student work. Monitor student's independent work. Classwork assigned. Homework assigned Exit cards.	

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Unit 5: Quadratic functions and Their Graphs

Summary of the Unit: In this unit, students will learn how to graph quadratic functions written in standard form, vertex form, and how to use the graph of a quadratic equation to solve it. Students will learn how to solve quadratic equations by factoring and using the quadratic formula. Students will learn how to use properties of radicals, how to use the value of discriminant to identify the number of real or imaginary solutions.

Enduring Understanding: Quadratic functions may be represented in a variety of forms (standard form, vertex form, or intercept form), and can be graphed in different ways based on the given form. Quadratic functions can be solved using a variety of techniques (factoring, finding square roots, completing the square, or using the quadratic formula), and the technique chosen comes after analyzing the function and thinking about the best course of action. Solving quadratic functions may produce complex solutions.

Essential Questions:
How does the graph of g(x) = (x – h) 2 + k compare with the graph of f(x) = x 2 ?
How does the graph of g(x) = ax 2 differ from the graph of f(x) = x 2 ?
How can you graph the function f(x) = a(x – h) 2+ k?
How do you convert quadratic functions to the vertex form f(x) = a(x – h) 2 + k?
How do you determine where the graph of a quadratic function crosses the x-axis?
How are quadratic models used to solve real-world problems?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
Websites may be used https://www.math-drills.com/
https://www.education.com/worksheets/math/
https://www.kutasoftware.com/
https://www.khanacademy.org/math
Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards
Graph Quadratic Functions in Standard Form	5 days	Graph a quadratic in standard form correctly. Identify the axis of symmetry, vertex, and solutions, if possible. Find the minimum or maximum value of a quadratic function by hand or by using the graphing calculator. Create a quadratic function to solve a minimum/maximum word problem.	• Graph, the "parent" quadratic function. • Define the standard form of a quadratic function, meaning of vertex, minimum/maximum, and axis of symmetry. • Use the graphing calculator to explore what changes in *a*, *b*, or *c* do to the graph. Discuss what makes a parabola open up vs open down. • Provide notes on the equation of the axis of symmetry, the *y*-intercept, and solutions (*x*-intercepts). • Practice making graphs of quadratics	Check student responses. Check student graphs. Check for correct use of graphing calculator. Classwork assigned. Homework assigned.	MA.9-12.F-IF.C.7a MA.9-12.F-IF.C.8a

			using a hand-generated table of values, then use the graphing calculator to verify.		
Graph Quadratic Functions in vertex Form	3 days	Identify the vertex form of quadratic functions. Convert the standard to vertex form by completing square. Graph a quadratic in vertex form correctly. Identify the axis of symmetry, vertex, and solutions, if possible.	• Formalize discussion on how to convert to vertex form and how to find the vertex, and how to create a table of values that includes the vertex, to sketch the graph. • Allow time for independent practice.	Check student responses. Check student graphs. Check for correct use of graphing calculator. Classwork assigned. Homework assigned. Q & A closure session.	MA.9-12.F-IF.C.7a MA.9-12.F-IF.C.8a
Solve Quadratic Equations	4 days	Solve quadratic functions by factoring and applying zero product property.	• Model solving quadratic functions by setting the problem equal to zero and use factoring to and zero	Assess students understanding via oral participation. Monitor student's independent work.	MA.9-12.A-APR.C.4 MA.9-12.A-REI.A.1 MA.9-12.A-REI.A.2

		Solve quadratic functions by applying the quadratic formula and use discriminant to identify number and type of solutions.	product property to identify x-intercepts. • Model solving multiple quadratic functions that results in different types of solutions. • Discuss the discriminant and that its value can predict the types of solutions there will be using previously modeled problems. • Include word problems that can be solved using the quadratic formula. • Remind students that the graphing calculator can be used to do checks.	Check student's results. Classwork assigned. Homework assigned. Q & A closure session.	MA.9-12.A-SSE.B.3a

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Unit 6: Rational Expressions and Equations

Summary of the Unit: In this unit, students will learn to simplify rational functions, to multiply, divide, add, and subtract rational expressions, and simplify complex fractions. Finally, Students will learn to solve rational equations.

Enduring Understanding: Rational functions have discontinuities where the denominator is equal to zero. Knowledge of adding, subtracting, multiplying, and dividing are extended to rational expressions. Rational equations may have extraneous solutions, so a check is always needed.

Essential Questions:
How do rational functions model real-world problems and their solutions?
How do you write and use inverse variation models?
How do you write and use joint variation models?
How do you multiply and divide rational expressions?
How do you add and subtract rational expressions?
How do you simplify complex fractions?
How do you solve rational equations?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
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https://www.kutasoftware.com/
https://www.khanacademy.org/math
Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards
Multiply and Divide Rational Expressions	2 days	Multiply and divide rational expressions	• Start with simplifying rational	Check student understanding via oral	MA.9-12.A-APR.D.6

		correctly by using factoring.	expressions first. • Factor numerator and denominator identify domain restrictions, then cancel common factors. Then move onto multiplying and dividing rational expressions. • Model, then provide practice problems.	participation. Check student work. Classwork assigned. Homework assigned.	
Add and Subtract Rational Expressions	2 days	Add and subtract rational expressions correctly after finding the LCD.	• Help students recall how to find the LCD in simple arithmetic problems and extend that knowledge to algebraic expressions (may have to factor denominators).	Check student understanding via oral participation. Monitor students independent practice. Check student work.	MA.9-12.A-APR.D.6

			• Provide a method to find the LCD, and then a way to make both denominators "match", to add or subtract correctly. • Model problems and provide practice problems.	Classwork assigned. Homework assigned. Exit cards.	
Solve Rational Equations	2 days	Solve rational equations by finding and multiplying through by the LCD to create a simpler equation to solve.	• Provide directions on how to solve rational equations by finding and multiplying through by the LCD to create a simpler equation to solve. • Remind students that a check must be done because extraneous solutions can occur.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned. Homework assigned Exit cards.	MA.9-12.A-APR.D.6 -

			• Model sample problems and provide practice. • See if students can point out when cross-multiplying can be used to solve rational		

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Cross Curricular/ 21st Century Connections:
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Unit 7: Matrices and Determinants

Summary of the Unit: In this unit students will learn about a matrix to organize data, how to identify the size of a matrix, apply operations on matrices, identify the inverse and determinant of a square matrix. Finally, students will learn solving systems of equations using the Cramer's Rule.

Enduring Understanding: Matrices can help solve real-life problems that are represented by systems of equations. Matrix operations have many practical applications. Determinants are often used in other branches of mathematics such as when changes of variables are made in calculus.

Essential Questions:
How are matrices used to model real world data and to solve real world problems?
How do you add and subtract matrices, multiply a matrix by a scalar, and solve matrix equations?
How do you multiply two matrices?
How do you evaluate determinants of 2x2 and 3x3 matrices?
How do you use Cramer's rule to solve systems of linear equations?
How do you find and use inverse matrices?
How do you solve systems of linear equations using inverse matrices?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
Websites may be used https://www.math-drills.com/
https://www.education.com/worksheets/math/
https://www.kutasoftware.com/
https://www.khanacademy.org/math
Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards

Matrices and System of Equations	5 days	Determine the size of a matrix. Use the definition of equal matrices to solve for missing elements.	• Identify the size of a matrix as number of rows by number of columns. • Explain the equal matrices they must have same size. Corresponding elements are equal. • Use equal matrices to solve for missing elements. • Allow time for independent practice.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned. Homework assigned Exit cards.	MA.9-12.N-VM.C MA.9-12.N-VM.C.9
Operations with Matrices	1 day	Multiply by a scaler. Add and Subtract Matrices. Multiply Matrices.	• A scaler is a constant that can be distributed to all elements of a matrix. • To add and subtract matrices, they must have the same size. Adding and subtracting corresponding elements.	Check student understanding via oral participation. Check student work. Monitor student's independent work.	MA.9-12.N-VM.B.5a MA.9-12.N-VM.C.7 MA.9-12.N-VM.C.8 MA.9-12.N-VM.C.10

			• To multiply two matrices, the number of columns in the first matrix must equal the number of rows in the second matrix. Multiply rows by columns. The size of ye resulting matrix is formed by the outer dimensions of the two original matrices. Multiplication of matrices is not commutative.	Classwork assigned. Homework assigned Exit cards.	
Inverse of a Square Matrix	2 days	Identify the inverse of 2x2 and 3x3 matrices.	• Demonstrate process of finding the inverse of 2x2 and 3x3 matrices using student's input to keep them involved. • Allow time for independent practice.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned.	MA.9-12.N-VM.C

				Homework assigned Exit cards.	
Determinant of a Square Matrix	2 days	Evaluate 2x2 and 3x3 determinants.	• Demonstrate process of finding the value of 2x2 and 3x3 determinants using student's input to keep them involved. • For 3x3 determinants, show both the diagonals and expansion by minor's methods. Have students compare the two techniques and pick their favorite method. • Allow time for independent practice.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned. Homework assigned Exit cards.	MA.9-12.N-VM.B.5a MA.9-12.N-VM.C.7 MA.9-12.N-VM.C.8 MA.9-12.N-VM.C.10
Cramer's Rule	2 days	Solve systems of equations using Cramer's rule.	• Demonstrate Cramer's rule in solving 2x2 and 3x3 systems of equations using guided practice.	Check student understanding via oral participation. Check student work.	MA.9-12.A-REI.C.9

			• Allow time for independent practice.	Monitor student's independent work. Classwork assigned. Homework assigned Exit cards.	

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Suggested Technological Innovations/ Use:
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Unit 8: Trigonometric Ratios, Right Triangle Trigonometry and Applications

Summary of the Unit: Students will learn the right triangle definitions of the six trigonometric functions and how to use right triangle trigonometry.

Enduring Understanding: The trigonometric ratios used in right triangle trigonometry are based on the concept of similar triangles. Concepts such at the Pythagorean Theorem are carried over from the study of Geometry. Trigonometric ratios can be found for acute angles using right triangle trigonometry.

Essential Questions:
What is the definition of the six basic trig functions in terms of the sides of a right triangle?
How does tangent relate to sine and cosine?
How does cotangent relate to secant and cosecant?
How can the six basic trig functions be used to solve right triangles?
What is the main difference between a trig function and its inverse?
How can inverse trig functions be used to calculate unknown angles in a right triangle?
How can your calculator fool you into thinking a wrong answer is correct?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
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https://www.kutasoftware.com/
https://www.khanacademy.org/math
Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards
Right Triangle Trigonometry	3 days	Solve right triangles using	• Review what students	Check student understanding	MA.9-12.F-TF.A.3

		properties of special right triangles and right triangle definitions of the six trigonometric functions. Solve for all missing parts of a right triangle, given two sides, or given one trigonometric ratio in the triangle.	can/should recall from Geometry: Pythagorean Theorem, Pythagorean triples, and 30-60-90 and • 45-45-90 triangles. Derive the relationships of the sides in the special right triangles, as needed. Point out trigonometric ratios are equal in similar triangles. Review right triangle trigonometry when solving for sides and using inverse trigonometry when solving for angles. • Introduce the reciprocal functions and	via oral participation. Check student work and diagrams. Check for correct use of graphing calculator (degree mode vs. radian mode). Classwork assigned. Homework assigned. Q & A Closure Session.	

			point out co-function relationships. • As time permits, discuss GPS, latitude and longitude, and converting angles in decimal degree to degree, minutes and seconds, and vice versa.		
Applications Using Trigonometric Ratios	2 days	Solve word problems involving angle of elevation and angle of depression.	• Demonstrate working on word problems that involve angle of elevation and angle of depression by using guided practice. • Allow time for independent practice in small groups.	Check student understanding via oral participation. Check student work. Monitor student's independent work. Classwork assigned.	MA.9-12.F-TF.A.3

				Homework assigned Exit cards.	

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Unit 9: Unit Circle, Radian Measure, and Periodic Functions

Summary of the Unit: Students will learn to use radian measure extend their understanding of the right triangle definitions of the six trigonometric functions and how to use right triangle trigonometry to evaluate trigonometric functions of any angle. Finally, Students are introduced to the graphs of sine, cosine, and tangent functions.

Enduring Understanding: Angles can be measured in degrees or radians. Trigonometric ratios can be found for acute angles using right triangle trigonometry and can be found for other types of angles using radian measure and/or the unit circle. Sine, cosine, and tangent functions are periodic. Sine and cosine functions oscillate about a midline, with a specific amplitude, and their domain is all real numbers. The parent tangent function is undefined for odd multiples of $\frac{\pi}{2}$, and has vertical asymptotes at those values.

Essential Questions:
What is the definition of a radian?
How can you convert from radians to degrees and vice versa?
How do you select Radian Mode or Degree Mode on your calculator?
What is the fundamental difference between a degree and a radian?
What is the arc length formula? (be sure to be able to define the variables)
What is angular velocity? How does it differ from linear velocity?
How does the arc length formula allow us to convert between angular and linear velocity?
When discussing angles in the Cartesian Plane, which axis is always the initial side?
Which direction of rotation is positive and which is negative?
How many radians represent a full revolution?
How can reflection over the y-axis, origin, and x-axis be used to easily determine the values of the six basic trig functions in any quadrant of the Cartesian Plane?
Under which conditions are two angles coterminal?
Why are important numbers when discussing coterminal angles?
How can the concept of coterminal angles be used to evaluate the six basic trig functions at any value?
What is the Unit Circle?
What trig function is represented by the x-axis? The y-axis?
How can the unit circle help us evaluate trig functions quickly?
How can the unit circle be used to help us identify angles for which certain trig functions are not define?

At which angles are tangent, cotangent, secant, and cosecant undefined?
How can symmetry and reflections be used to help you quickly memorize the unit circle?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
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https://www.education.com/worksheets/math/
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Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards
Define General Angles and Use Radian Measure	7 days	Define angles in standard position, initial side, and terminal side; distinguish between positive and negative angles; Convert angles from degree to radian and vice versa, find co-terminal angles, complementary angles and supplementary angles, and sketch angle (both in degree	• Intro key vocabulary: Angle, made by rotating a ray about a point, Angle in standard position, vertex, initial ray, terminal ray, positive angle, negative angle. • Draw a positive angle and negative angle that are co- terminal and have student supply definition of	Check student understanding via oral participation. Check student work and diagrams. Classwork assigned. Homework assigned. Exist Cards.	MA.9-12.F-TF.A.1 MA.9-12.F-TF.A.2

		measure and radian measure). Define radian in terms of the measure of the central angle of a circle. Find arc length and area of a sector.	co- terminal. • Recall Quadrants, degrees in full and • ½ rotation, complementary, supplementary, acute, right, obtuse, reflexive, angles greater than 360 and Quadrantal angles. • Write the definition of radian on the board, ask students to read. What does it mean? To explain, draw a circle on the board and draw in a radius (where initial ray in standard position would be). Cut a length of twine equal to the length of the radius. Use the		

			twine to measure an arc on the circle. Draw terminal ray to meet end of arc. That central angle is a radian. Have students estimate the degree measure (about 60° is fine for now.). • Intro formula for $s=r\theta$. In a circle, $C=2\pi r$, and circumference is an arc made rotating and angle a full rotation. Plug into $s=r\theta$ to show a full rotation in radians is 2π. • Draw xy axes, and label radian measures for 0, 90, • 180, 270 and 360 • degrees. Draw		

			xy axes again, and draw 1, 2, 3, 4, 5, 6 • radians….a bit more than 3 fit in 180 • degrees (3.14!). • Also show area of a sector formula, and where is comes from A=1/2(r^2)π. • Develop conversion factor for degrees and radians from the fact that 180°=π radians. Show what 1° equals and what one radian equals (and use a calculator to show it is about 57°). • Formalize: To convert degrees to radians, multiply		

			degrees by π/180 degrees; and to convert radians to degrees, multiply radians by 180 degrees/π. • Introduce 17 special angles, and how to find the radian measures quickly. • Review co-terminal, complementary and supplementary angles, and find them in radian measure (review fraction work as needed).		
Evaluate Trigonometric Functions of Any Angle		Find reference angles and evaluate the trigonometric function of any special angle using reference angles.	• Define a reference angle for an angle θ (the reference angle, θ', is the acute angle between the terminal ray of	Check student understanding via oral participation. Check student work.	MA.9-12.F-TF.A.1 MA.9-12.F-TF.A.2

		Given an ordered pair on the terminal ray of an angle in standard position, SWBAT evaluate the 6 trigonometric functions of that angle. Predict the sign of a trigonometric function depending on the Quadrant its terminal ray lies in. Use this knowledge to develop the definitions of the 6 trigonometric functions based on *x*, *y*, and *r*. Evaluate trigonometric functions of any angle with respect to *x*, *y*, and *r* (including quadrantal angles).	the angle θ and the horizontal axis). Draw an angle in each of the 4 quadrants and have students show where the reference angle is. Then give an angle measure for θ, and have students find the measure of θ' (start with degrees i.e. 300, - 135, and then formalize process, so they can do this for radian measure • i.e. 3π/4). • Review sides of 30- 60-90 and 45-45-90 • triangles. Then, given a special angle θ, find θ', and use θ' to draw a special right triangle and evaluate the 6	Monitor student's independent work. Check student's created unit circles. Classwork assigned. Homework assigned Exit cards.	

			trig functions for that angle (use right triangle trigonometry). • Practice: given a point on the terminal ray of an angle θ, find sin θ, cos θ and tan θ. Expand definition to include points on terminal ray of an angle (*x*, *y*) more/less than one unit away from the origin • Have students come up with the definitions of the 6 trigonometric functions in terms of *x*, *y*, and *r*. Expand exploration to have students predict the sign of the 6 trigonometric functions in each quadrant based on		

			the signs of the (x, y) pair. • Do problems where one trigonometric ratio of an angle and the Quadrant where the terminal ray lie are given and find the remaining trigonometric functions. Or problems where one trigonometric ratio of an angle is given, and the sign of another trigonometric ratio is given, find the remaining ratios. • Students make their own unit circle.		
Graph Sine, Cosine, and Tangent Functions	4 days	Sketch the graphs of sine and cosine functions, after identifying amplitude, period, and the 5 key points needed to sketch the graph.	• Provide sketches of the parent graphs of y=sin x and y=cos x, and discuss domain, range, amplitude, period, and x-intercepts (note the 5 key points that are needed to sketch a complete curve).	Check student understanding via oral participation. Check student graphs. Monitor student's independent	MA.9-12.F-TF.A.4

		Sketch the graph of the tangent function after identifying period and asymptotes.	Discuss and practice graphing y=a sin b*x* and y= a cos b*x*, making changes in *a* and *b*. • Repeat for the graphs of y=tan *x* and y=a tan b*x*, discussing period, domain (results in vertical asymptotes), range, and *x*-intercepts.	work. Classwork assigned. Homework assigned Exit cards.	

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Unit 10: Descriptive Statistics

Summary of the Unit: In this unit, students will study the Fundamental Counting Principle, permutations (with and without repetition), and combinations (simple or multiple events). Students will examine the patterns found in Pascal's triangle and apply these patterns to binomial expansions.

Enduring Understanding: There are many ways to count the number of possibilities, but it depends on whether order matters. Probabilities can also be computed, but you must be mindful of whether events are independent or dependent.

Essential Questions:
How do you use the fundamental counting principle to count the number of ways an event can happen?
How do you use permutations to count the number of ways an event can happen?
How do you use combinations to count the number of ways an event can happen?
How do you find theoretical and experimental probabilities?
How do you find geometric probabilities?
How do you use compliments to find the probability of an event?
How do you find the probability of independent events?
How do you find the probability of dependent events?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Section Quizzes, End of Unit Tests, and End of Quarter Exam

Resources:
Websites may be used https://www.math-drills.com/
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Worksheets, Online assignments, and Textbook

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	Common Core or NJCCCS Standards

The Counting Principle	3 days	Use the Fundamental Counting Principle.	• Define key vocabulary such as outcome, sample space, event, and independent vs. dependent. • Introduce the idea of ways to count by hand, such as with a tree diagram or a table. • Introduce the Fundamental Counting Principle and provide practice problems using it (both independent and dependent events).	Check student understanding via oral participation. Check student work. Check for correct use of graphing calculator. Classwork assigned. Homework assigned. Q & A Closure Session.	MA.9-12.N-Q.A.1 MA.9-12.N-Q.A.3
Permutations and Combinations	3 days	Solve problems using permutations and permutations with repetition. Solve problems using combinations and combinations with multiple events.	• Define a permutation and introduce factorial notation. • Introduce the permutation formula and show how to use it in the graphing calculator. • Show the formula	Check student understanding via oral participation. Check student work. Check for correct use of graphing	MA.9-12.F-IF.A.2

			for permutation with repetition and provide practice problems to use it. • Define a combination. • Introduce the combination formula and show how to use it in the graphing calculator. • Provide practice problems with simple events, and multiple events.	calculator. Classwork assigned. Homework assigned. Q & A Closure Session.	
Use Combinations and the Binomial Theorem	3 days	Use the Binomial Theorem to expand a power of a binomial expression completely, or to find a specific term in the expansion.	• Introduce Pascal's Triangle using numbers, and then using combinations. • Solve problems such as "How many different combinations of 2 Model UN members can be chosen from the 6 Model UN students in the club?" using Pascal's Triangle	Check student understanding via oral participation. Check student work. Check for correct use of graphing calculator. Classwork assigned.	MA.9-12.F-IF.A.2

			(confirm with combinations). • Then expand $(aa + bb)^n$ for n=0, 1, 2, 3, and 4, and show that the coefficients match Pascal's Triangle. • Introduce the Binomial Theorem, then use it to expand $(xx^2 + yy)^3$ and other practice problems. • As time permits, find specific terms or coefficients of terms, using knowledge of the Binomial Theorem	Homework assigned. Q & A Closure Session.	

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