

Saint Patrick High School

Curriculum Guide

Department:	Mathematics	Grade and Level:	09
Class:	H Advanced Algebra	Term (Semester or Year):	Year

Required Text:	• None - Unit Packets Provided by Teacher
Additional Resources (i.e. texts, materials, apps, etc.):	<u>iPad Apps</u> Showbie GoodReader iBooks iTunes U Educreations Nearpod <u>Other</u> Graphing Calculator Kuta Software

Course Description

This course will enable the honors student to continue acquiring knowledge of the world of algebra. The course will begin with a review of topics from the first year algebra course, with an aim for a more in-depth and complete understanding of algebraic theory and methods. Emphasis will shift to more advanced algebraic topics including radical functions, rational exponents, exponential and logarithmic functions, rational functions, sequences and series, and matrices. A major aim of this course is to prepare the student for the rigors of a college level mathematics course. There will also be an emphasis on ACT Exam Preparation.

Unit Themes (Table of Contents)

Theme 1:	Expressions, Equations and Inequalities
Theme 2:	Functions, Equations and Graphs
Theme 3:	Linear Systems
Theme 4:	Quadratic Functions and Equations
Theme 5:	Rational Functions
Theme 6:	Polynomials and Polynomial Functions
Theme 7:	Radical Functions and Rational Exponents
Theme 8:	Exponential and Logarithmic Functions
Theme 9:	Probability and Statistics

Agreed Upon Assessments

Forms of assessments may include but are not limited to....

- Mid Chapter Quizzes
- Unit Exams
- Lectures/Discussions
- Group Projects
- Presentations
- Homework Assignments
- Homework Quizzes

Research and Writing Expectations

- Students are required to write detailed solutions to the exercises that they solve
- Analysis questions are also presented, where students are required to explain why a given statement or solution is true or false

Unit 1:	Expressions, Equations and Inequalities
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Standards Addressed:

- *A.SSE.3* Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression
- *N.RN.3* Explain why sums and products of rational numbers are rational, etc.
- *A.SSE.1.a* Interpret parts of an expression, such as terms, factors and coefficients
- *A.CED.1* Create equations and inequalities in one variable and use them to solve problems.
- *A.CED.4* Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations
- *A.CED.1* Create equations and inequalities in one variable and use them to solve problems.
- *A.SSE.1.b* Interpret complicated expressions by viewing one or more of their parts as a single entity.
- *A.CED.1* Create equations and inequalities in one variable and use them to solve problems.

Essential Questions:

- How can I use algebraic expressions to describe patterns?
- How are the subsets of the real numbers related?
- How can I represent mathematical phrases and real world quantities using algebraic expressions?
- How can I use the properties of equality and inverse operations to solve equations and inequalities?
- What methods can I use to solve absolute value equations and inequalities?

Affirmation Statements:

Students will be able to...:

- represent some patterns using diagrams, words, numbers or algebraic expressions
- graph and order real numbers
- identify properties of real numbers
- evaluate algebraic expressions
- simplify algebraic expressions
- solve linear equations
- solve problems by writing equations
- solve and graph inequalities
- write and solve compound inequalities
- write and solve equations and inequalities involving absolute value

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Unit 2:	Functions, Equations and Graphs
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Standards Addressed:

- *F.IF.1* Understand that a function assigns to each element of the domain exactly one element of the range
- *F.IF.2* Evaluate functions for inputs in their domains, and interpret statements
- *A.CED.2* Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- *F.IF.8* Write a function defined by an expression in different but equivalent forms
- *F.IF.9* Compare properties of two functions each represented in a different way
- *F.BF.3* Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x+k)$ for specific values of k . Find the value of k given the graphs.

Essential Questions:

- What methods can we use to determine whether or not a relation is a function?
- How can I identify a direct variation?
- What are different ways in which I can write the equation of a line?
- What is the relationship between the slopes of parallel and perpendicular lines?
- How does the graph of a function relate to its parent function?
- How do you use transformations to help graph absolute value functions?
- How does graphing an inequality in two variables relate to graphing a line?

Affirmation Statements:

Students will be able to...:

- graph relations
- identify functions
- write and interpret direct variation equations
- graph linear equations
- write equations of lines
- write an equation of a line given its slope and a point on the line
- analyze transformations of functions
- graph absolute value functions
- graph two-variable inequalities

Common Assessments:

- Unit Exam

- Mid Chapter Quiz
- Homework Assignments

Unit 3:	Linear Systems
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Standards Addressed:

- *A.CED.2* Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- *A.REI.6* Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables.
- *A.REI.12* Graph solutions to a linear inequality in two variables as a half-plane and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes
- *A.REI.8* Represent a system of linear equations as a single matrix equation in a vector variable

Essential Questions:

- How can I use graphing to solve a system of equations?
- How can I solve a system of equations algebraically?
- What are the possibilities for solutions to a system of equations?
- How does solving a system of inequalities relate to solving a system of equations?
- How can I use algebraic methods to solve a system in three variables?
- How can I use Cramer's Rule to solve a system of equations

Affirmation Statements:

Students will be able to...:

- solve a linear system using a graph
- solve linear systems using substitution
- solve linear systems using elimination
- solve systems of linear equations
- solve systems in three variables using substitution
- solve systems in three variables using elimination
- solve systems using Cramer's Rule

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Unit 4:	Quadratic Functions and Equations
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Standards Addressed:

- *F.BF.3* Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x+k)$ for specific values of k . Find the value of k given the graphs.
- *A.CED.2* Create equations in two or more variables to represent relationship between quantities; graph equations on coordinate axes with labels and scales.
- *F.IF.5* Relate the domain of a function to its graph and to the quantitative relationship it describes.
- *A.SSE.2* use the structure of an expression to identify ways to rewrite it.
- *A.CED.1* Create equations and inequalities in one variable and use them to solve problems.
- *A.APR.3* Identify zeros of polynomials when suitable factorizations are available.
- *A.REI.4.b* Solve quadratic equations by completing the square
- *A.REI.4.b* Solve quadratic equations by the quadratic formula
- *N.CN.1* Know there is a complex number i such that $i^2 = -1$ and every complex number has the form $a + bi$ with a and b real

Essential Questions:

- How does the graph of a quadratic function relate to the parent function $y = x^2$?
- What do the values of a , b and c tell us about a quadratic function?
- How can I use the coordinates of three noncollinear points to write the equations of a quadratic function that contains them?
- What methods can I use to factor a quadratic expression?
- What methods can I use to find the zeros of a quadratic equation?
- How do I solve a quadratic equation if I cannot factor the expression?
- What does the discriminant of a quadratic equation tell me about the number and type of solutions?
- How do complex number operations relate to real number operations?

Affirmation Statements:

Students will be able to...:

- identify and graph quadratic functions in vertex form
- graph quadratic functions written in standard form
- model data with quadratic functions
- find common and binomial factors of quadratic expressions
- factor special quadratic expressions
- solve quadratic equations by factoring and by graphing
- rewrite function by completing the square
- solve equations by completing the square
- solve quadratic equations by using the Quadratic Formula
- determine the number of solutions to a quadratic equation by using the discriminant
- identify, graph and perform operations with complex numbers
- find complex number solutions of quadratic equations

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Unit 5:	Rational Functions
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Standards Addressed:

- *A.SSE.2* Use the structure of an expression to identify ways to rewrite it
- *A.SSE.1.b* Interpret complicated expressions by viewing one or more of their parts as a single entity.
- *A.APR.7* Add, subtract, multiply and divide rational expressions

Essential Questions:

- How can I use what I know about fraction operations to add, subtract, multiply and divide rational expressions?
- What methods can I use to solve a rational equation?

Affirmation Statements:

Students will be able to...:

- simplify rational expressions
- multiply and divide rational expressions
- add and subtract rational expressions
- simplify complex fractions
- solve rational equations
- use rational equations to solve problems

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Unit 6:	Polynomials and Polynomial Functions
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Standards Addressed:

- *F.FI.7.c* Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior

- *A.REI.11* Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are solutions of the equations $f(x) = g(x)$
- *A.APR.2* Know and apply the Remainder Theorem
- *N.CN.7* Solve quadratic equations with real coefficients that have complex solutions
- *N.CN.8* Extend polynomial identities to the complex numbers
- *A.APR.5* Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers, with coefficients determined by Pascal's Triangle

Essential Questions:

- What does the algebraic form of a polynomial tell me about the graph of the function and vice versa?
- How does finding the zeros of a polynomial function help factor, graph, and solve?
- How does synthetic division aid in finding the zeroes of a polynomial function?
- How do the factors of the leading and trailing coefficients of a polynomial function help factor and solve the function?
- What does the degree of a polynomial equation tell about the number of roots?
- How can I use patterns to expand a binomial?

Affirmation Statements:

Students will be able to...:

- classify polynomials
- graph polynomial functions and describe end behavior
- analyze the factored form of a polynomial
- write a polynomial function from its zeroes
- solve polynomial equations by factoring
- solve polynomial equations by graphing
- divide polynomials using long division
- divide polynomials using synthetic division
- solve equations using the Rational Root Theorem
- use the Conjugate Root Theorem
- use the F.T.A to solve polynomial equations with complex solutions
- expand a binomial using Pascal's Triangle
- use the Binomial Theorem

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Standards Addressed:

- *A.SSE.2* Use the structure of an expression to identify ways to rewrite it.
- *N.RN.2* Rewrite expressions involving radicals and rational exponents using the properties of exponents
- *A.REI.2* Solve simple rational and radical equations in one variable and show how extraneous solutions may arise
- *A.CED.4* Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- *F.BF.1.b* Combine standard function types using arithmetic operations.
- *F.BF.1.c* Compose functions
- *F.BF.4.a* Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse

Essential Questions:

- How does finding higher order roots relate to finding square roots?
- How do I simplify radical expressions with higher order roots?
- How do the properties of real numbers aid in combining like radicals?
- How can I equivalently write a radical expression using exponents?
- When do extraneous solutions arise in solving square root equations?
- How does the domain of a function affect its combination or composition with another?
- What methods can I use to find the inverse of a function?

Affirmation Statements:

Students will be able to...:

- find n th roots
- multiply and divide radical expressions
- add and subtract radical expressions
- simplify expressions with rational exponents
- solve square root and other radical equations
- add, subtract, multiply and divide functions
- find the composite of two functions
- find the inverse of a relation or function

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Unit 8:	Exponential and Logarithmic Functions
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Standards Addressed:

- *F.IF.7.e* Graph exponential functions, showing intercepts and end behavior
- *A.CED.2* Create equations in two or more variables to represent relationships between quantities
- *F.IF.8* Write a function defined by an expression in different but equivalent forms
- *F.BF.4.a* Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write the inverse
- *F.LE.4* For exponential models, express as a logarithm the solution to $ab^{(ct)} = d$ where a , c , and d are numbers and the base b is 2, 10 or e ; evaluate the logarithm using technology.

Essential Questions:

- What types of situations are appropriately modeled by exponential functions?
- How does the value of a affect the graph of an exponential function?
- How does a logarithm relate to an exponential function?
- What properties do exponentials and logarithms have?
- What methods can I use to solve equations involving logarithms or exponential functions?
- What is the natural base and where does it apply?

Affirmation Statements:

Students will be able to...:

- model exponential growth and decay
- explore the properties of functions of the form $y = ab^x$
- graph exponential functions that have the base e
- write and evaluate logarithmic expressions
- graph logarithmic functions
- use the properties of logarithms
- use the Change of Base formula
- solve exponential and logarithmic equations
- evaluate and simplify natural logarithmic expressions
- solve equations using natural logarithms

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments

Unit 9:	Probability and Statistics
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Standards Addressed:

- *S.CP.9* Use permutations and combinations to compute probabilities of compound events and solve problems
- *S.IC.2* Decide if a specified model is consistent with results from a given data generating process
- *S.CP.7* Apply the Addition Rule $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ and interpret the answer in terms of the model
- *S.CP.6* Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A.
- *S.MD.6* Use probabilities to make fair decisions
- *S.MD.7* Analyze decisions and strategies using probability concepts

Essential Questions:

- How does the Fundamental Counting Principle aid in finding probabilities of certain events?
- What methods can I use to find theoretical probabilities?
- How do I find the probability of two events occurring together?
- How do I find the probability of one event dependent on another?
- What are different ways that I can describe and compare sets of data?

Affirmation Statements:

Students will be able to...:

- count permutations
- count combinations
- find the probability of an event using theoretical, experimental and simulations methods
- find the probability of the event A and B
- find the probability of the event A or B
- find conditional probabilities
- use tables and tree diagrams to determine conditional probabilities
- calculate measures of central tendency
- draw and interpret box and whisker plots

Common Assessments:

- Unit Exam
- Mid Chapter Quiz
- Homework Assignments