DELAWARE VALLEY SCHOOL DISTRICT

PLANNED INSTRUCTION

A PLANNED COURSE FOR:

Precalculus

Curriculum Writing Committee:

Elizabeth Katz, Christine Marcial

Grade Level: 11

Date of Board Approval: _____2024_____

Course Weighting:

Course Weighting: Precalculus

Marking Period	Quiz	Test	Homework	Total
MP1	160	200	40	400
MP2	160	200	40	400
MP3	160	200	40	400
MP4	160	300 (with final)	40	500
Total Points	640	900	160	1700
Total Percents	38%	53%	9%	100%

Curriculum Map

Overview:
This course is designed to prepare students for the high school instruction by challenging them to develop real-world problem-solving skills, critical thinking skills and communication skills in the area of mathematics. Students will study various properties of functions and will analyze the graphs and applications of the studied functions. The properties of functions analyzed will be the domain, range, intercepts, increasing intervals, decreasing intervals, constant intervals, graphs, maxima, minima, key points, and asymptotes. Students will also analyze real life applications and connections to banking, physics, biology, chemistry, social sciences, and economics.

Students will have the opportunity to use a variety of learning methods to attain mastery of the skills and concepts necessary for success. Students will demonstrate a mastery through explicit applications, collaboration with peers, guided inquiry, and direct instruction. Technology is integrated whenever appropriate to support and challenge the learning of the students. Such technological instruction will be through the use of graphing calculators and/or internet-based learning sites.

Time/Credit for the Course: Full year, 180 days; 1 credit; 1 period per day

DELAWARE VALLEY SCHOOL DISTRICT

Goals:

Understanding of:

Marking Period 1: Overview based on 45 days

Unit 1: Functions and Their Graphs

- Data analysis and percentages - SAT review
- Distance formula, midpoint formula, intercepts, and symmetry
- Writing equations of and graphing circles
- Defining functions
- Properties of the library of functions: linear, quadratic, absolute value, square root, piecewise, constant, identity, cubic, cube root, and reciprocal functions
- Graphing techniques of functions: transformations, both by hand and with graphing utility
- Mathematical models and applications of functions

Marking Period 2: Overview based on 45 days.

Unit 1 Continued: Functions and Their Graphs

- Quadratic functions and their properties
- Quadratic models
- Quadratic equations and inequalities

Unit 2: Polynomials and Rational Functions

- Polynomial functions and models
- Real and complex zeros of polynomial functions
- Properties of rational functions
- Graphs of polynomial and rational functions
- Polynomial and rational equations and inequalities

Marking Period 3: Overview based on 45 day

Unit 3: Exponential and Logarithmic Functions

- Evaluating and writing composite functions
- One-to-one functions and their inverses
- Exponential functions and their properties
- Logarithmic functions and their properties
- Logarithmic and exponential equations
- Applications of exponential and logarithmic equations

Unit 4: Trigonometric Functions

- Angles and their measure in radians and degrees
- Trigonometric functions with a Unit Circle approach in degrees and radian measures
- Properties of the trigonometric functions
- Graphs of sine, cosine, tangent, cosecant, cotangent, and secant

Marking Period 4: Overview based on 45 days

Unit 4 Continued: Trigonometric Functions

- Phase shifts with trigonometric functions: inverse sine and cosine functions
- Elementary trigonometric identities: quotient, reciprocal, Pythagorean, even-odd
- Sum and difference formulas

- Double angle and half-angle formulas
- Finding all solutions of a trigonometric equation
- Trigonometric equation quadratic in form
- Solving trigonometric equations by using identities
- Applications involving right triangle trigonometry
- The Law of Sines
- The Law of Cosines
- Heron's Formula and the area of a triangle using trigonometry
- Common Final Assessment

Big Ideas:

Big Idea # 1: Numbers, measures, expressions, equations, and inequalities can represent mathematical situations and structures in many equivalent forms.

Big Idea #2: Families of functions exhibit properties and behaviors that can be recognized across representations. Functions can be transformed, combined, and composed to create new functions in mathematical and real-world situations.

Big Idea #3: Mathematical functions are relationships that assign each member of one set (domain) to a unique member of another set (range), and the relationship is recognizable across representations.

Big Idea #4: Mathematical relations and functions can be modeled through multiple representations and analyzed to raise and answer questions.

Primary Textbook(s) and Supplemental Resources:

Name of Textbook: Sullivan & Sullivan Precalculus Enhanced with Graphing Utilities 7th Edition

Textbook ISBN #: 0-13-430837-9

Textbook Publisher &Year of Publication: Pearson, 2017

Supplemental Resources:

- Sullivan & Sullivan student resources
- TI-84 Plus Graphing calculator
- TI-SmartView for the Smartboard
- Smart notebook gallery essentials
- Software: IXL, Kuta, Desmos etc.
- Websites such as Khan Academy and College Board

Curriculum Plan

Unit 1: Functions and Their Graphs 62 days

Standard(s): Common Core State Standards for Mathematics
http://static.pdesas.org/content/documents/PA%20Core%20Standards%20Mathematics%20PreK-12%20March%202014.pdf

Standards Addressed:

CC.2.4.8.B.1	CC.2.1.HS.D.2	CC.2.1.HS.D.10	CC.2.3.HS.A.1
CC.2.4.HS.B.1	CC.2.1.HS.D.3	CC.2.2.HS.C.1	CC.2.3.HS.A.11
CC.2.4.HS.B.2	CC.2.1.HS.D.4	CC.2.2.HS.C.2	CC.2.4.HS.B.1
CC.2.4.HS.B.3	CC.2.1.HS.D.7	CC.2.2.HS.C.3	CC.2.4.HS.B.2
CC.2.1.HS.F.3	CC.2.1.HS.D.8	CC.2.2.HS.C.4	CC.2.4.HS.B.3
CC.2.1.HS.D.1	CC.2.1.HS.D.9	CC.2.2.HS.C.5	

Anchors:

- M08.B-E.1 Demonstrate an understanding of expressions and equations with radicals and integer exponents.
- M08.B-E.2 Understand the connections between proportional relationships, lines, and linear equations.
- M08.B-E.3 Analyze and solve linear equations and pairs of simultaneous linear equations.
- M08.B-F.1 Analyze and interpret functions.
- M08.B-F.2 Use functions to model relationships between quantities.
- A2.1.2.1 Use exponents, roots, and/or absolute values to represent equivalent forms or to solve problems.
- A2.1.2.2 Simplify expressions involving polynomials.
- A2.2.2.2 Describe and/or determine families of functions.

Eligible Content:

- Determine whether a number is rational or irrational.
- Apply one or more properties of integer exponents in order to generate equivalent numerical expressions.
- Use square root and cube root symbols to represent functions.
- Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear.
- Graph proportional relationships, interpreting the unit rate as the slope of the graph.
- Compare two different proportional relationships represented in different ways.
- Determine whether a relation is a function.

- Compare properties of two functions represented in different ways (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions).
- Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph.
- Interpret the rate of change and initial value of a function in terms of the situation it models and in terms of its graph or a table of values.
- Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear).
- Sketch or determine a graph that exhibits the qualitative features of a function that has been described.

Objectives: Students will be able to

- Choose an appropriate graphical representation for a given data set (DOK Level 2)
- Analyze and interpret numerical data distributions (DOK Level 2)
- Use the distance and midpoint formula (DOK Level 1)
- Graph equations by plotting points (DOK Level 2)
- Find intercepts from a graph and an equation (DOK Level 1)
- Test an equation algebraically for symmetry with respect to the x-axis, the y-axis, and the origin (DOK Level 3)
- Solve equations using a graphing utility (DOK Level 2)
- Calculate and interpret the slope of a line (DOK Level 1)
- Graph lines given a point and the slope (DOK Level 2)
- Find the equation of a vertical and a horizontal line (DOK Level 1)
- Use the point-slope form of a line (DOK Level 1)
- Determine the equation of a line given two points (DOK Level 2)
- Write the equation of a line in point-slope form, slope-intercept form and standard form (DOK Level 2)
- Identify the slope and y-intercept of a line from its equation (DOK Level 1)
- Write the equation of a secant line to a graph (DOK Level 2)
- Formulate equations of parallel and perpendicular lines (DOK Level 3)
- Write the equation of a circle in various forms (DOK Level 2)
- Graph a circle in various forms by completing the square (DOK Level 1)
- Determine whether a relation represents a function (DOK Level 3)
- Calculate the value of a function (DOK Level 1)
- List the domain and the range of a function (DOK Level 2)
- Perform operations on functions (DOK Level 3)
- Identify the graph of a function (DOK Level 1)
- Obtain information from or about the graph of a function (DOK Level 3)
- Determine and identify even and odd functions (DOK Level 2)
- Use a graph to determine where a function is increasing, decreasing, or constant (DOK Level 2)

- Use a graph to locate local maxima and local minima (DOK Level 2)
- Find the average rate of change of a function (DOK Level 2)
- Graph the following functions: linear, quadratic, absolute value, square root, piecewise, constant, identity, cubic, cube root, and reciprocal (DOK Level 3)
- Graph functions using transformations (DOK Level 3)
- Analyze non-routine transformations of graphs, such as absolute value and/or reciprocal of a given function (DOK Level 4)
- Identify the vertex and axis of symmetry of a quadratic function (DOK Level 2)
- Graph a quadratic function using its vertex, axis of symmetry, and intercepts using various forms (DOK Level 3)
- Solve quadratic equations by graphing (identifying the x-intercepts), factoring, completing the square, and using the quadratic formula (DOK Level 3)
- Build and analyze functions and models (DOK Level 4)
- Solve inequalities involving a quadratic function algebraically and graphically (DOK Level 3)
- Choose an appropriate graphical representation for a data set (DOK Level 2)

Core Activities and Corresponding Instructional Methods:

- Review and expand students' knowledge on finding the domain and range of a function, identifying even and odd functions, evaluating functions, analyzing graphs of functions, and finding the average rate of change of functions.
    - Suggested Practice Exercises: Sullivan/Sullivan Precalculus Textbook *Skill Building* - Chapters 1-3 Sections: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4, 3.5
    - Diagnostic assessment, questioning
    - Cooperative learning groups
    - Direct instruction as needed using Smart Technology after the students have learned how to graph a function by hand and have mastered transformations of graphs.
        - Sullivan/Sullivan Precalculus Textbook - Sections 2.2 and 2.5
        - Guided practice using online resources and worksheets
- Integrate academic and content specific SAT practice to analyze and interpret analytical and data distribution and choose an appropriate graphical representation for a given data set.
    - Suggested Activity: Student SAT/PSAT practice generated by www.collegeboard.org or www.khanacademy.org through warm-up exercises, homework assignments and/or classroom discussions
- Integrate academic and content specific vocabulary.
    - Suggested Practice Exercises: Sullivan/Sullivan Precalculus Textbook *Concepts and Vocabulary* Chapters 1-3 Sections: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4, 3.5
    - Direct instruction and practice on the various parent functions (linear, quadratic, cubic, cube root, piecewise, square root, constant, identity, power, polynomial,

greatest integer, reciprocal, logarithmic, absolute value, exponential, and trigonometric)
    - Classroom discussion that prompts students to compare and contrast various properties of functions using appropriate vocabulary
    - Suggested Application: Chapter Project - *Determining the Selling Price of a Home* (Sullivan/Sullivan Precalculus Textbook - Page 55)
    - Guided practice including step-by-step written/verbal instruction using necessary vocabulary of functions (even, odd, domain, range, compression, stretch, reflection, inverse, one-to-one)
- Utilize the graphing calculators with TI-SmartView and paper-pencil to support key vocabulary and learned skills
- Incorporating appropriate math language in writing
    - Suggested Application: Chapter Project -*The Beta of a Stock* (Sullivan/Sullivan Precalculus Textbook - Page 179)
- Analyze functions and their transformations in the coordinate plane
    - Direct instruction by using visual demonstration of sets of points in the Cartesian coordinate plane by hand and in the TI-84 graphing calculator
    - Classroom discussion by using content specific vocabulary
        - Suggested Activity: Desmos Marbleslides Lines
            - https://teacher.desmos.com/activitybuilder/custom/566b31734e38e1e21a10aac8?collections=featured-collections,5e73b204d560367270838c4b
        - Suggested Activity: Desmos Marbleslides Parabolas
            - https://teacher.desmos.com/activitybuilder/custom/566b31784e38e1e21a10aade
- Identify properties of functions and graph functions
    - Direct instruction and classroom discussion about properties: intervals of increase, intervals of decrease; constant intervals; local extrema and intercepts supported by visual aids on the Smart Board
    - Guided practice: Include step-by-step written/verbal explanation of the behavior of a graph
    - Cooperative group activities
        - Suggested Application using Excel or Google Sheets: Chapter Project - *Choosing a Wireless Data Plan* (Sullivan/Sullivan Precalculus Textbook - Page 128-129)
        - Graphing utility practice (TI-SmartView and TI-84 graphing calculators)
- Develop students' ability to solve real world applications by applying their understanding of various functions and their properties
    - Cooperative learning groups
    - Suggested Activity: *Bouncing Tennis Balls Linear Regression Lab*
- Step-by-step written/verbal explanation of the behavior of a graph
    - Desmos activities (www.desmos.com): *Functions: 8 Applications.* Designed investigations for a classroom with an introduction to functions

- Graphing utility (TI-SmartView and Ti-84 graphing calculators) exploration

Assessments:

Diagnostic:

- Teacher prepared diagnostic questions
- Teacher observation

Formative:

- Teacher observations, questioning techniques
- Group activities involving verbal and written justification showing all steps, drawing conclusions, estimating, citing evidence, and developing logical arguments.
- Homework:
  - Example problems from the Sullivan/Sullivan textbook for chapters 1-3 sections: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4, 3.5
  - Teacher made worksheets and applications
  - Khan Academy assignments
  - College Board question banks
  - Online resources such as IXL assignments
- Individual, independent quizzes Chapters 1-3

Summative:

- Departmental Common Assessment Chapter Exams 1-3

Unit 2: Polynomial and Rational Functions 29 days

Standard(s): Common Core State Standards for Mathematics
http://static.pdesas.org/content/documents/PA%20Core%20Standards%20Mathematics%20PreK-12%20March%202014.pdf

Standards Addressed:

CC.2.1.HS.F.1	CC.2.1.HS.D.1	CC.2.1.HS.D.6	CC.2.1.HS.D.10
CC.2.1.HS.F.3	CC.2.1.HS.D.2	CC.2.1.HS.D.7	CC.2.2.HS.C.1
CC.2.1.HS.F.6	CC.2.1.HS.D.3	CC.2.1.HS.D.8	CC.2.2.HS.C.2
CC.2.1.HS.F.7	CC.2.1.HS.D.4	CC.2.1.HS.D.9	CC.2.2.HS.C.3

Anchors:

- M08.B-E.1 Demonstrate an understanding of expressions and equations with radicals and integer exponents.
- M08.B-F.1 Analyze and interpret functions
- M08.B-F.2 Use functions to model relationships between quantities
- A2.1.2.1 Use exponents, roots, and/or absolute values to represent equivalent forms or to solve problems.
- A2.1.2.2 Simplify expressions involving polynomials.
- A2.2.2.2 Describe and/or determine families of functions.

Eligible Content:

- Apply one or more properties of integer exponents to generate equivalent numerical expressions.
- Use square root and cube root symbols to represent functions.
- Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear.
- Graph proportional relationships, interpreting the unit rate as the slope of the graph.
- Determine whether a number is rational or irrational.
- Compare two different proportional relationships represented in different ways.
- Determine whether a relation is a function.
- Compare properties of two functions represented in different ways (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions).Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph.
- Interpret the rate of change and initial value of a function in terms of the situation it models and in terms of its graph or a table of values.
- Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear).

- Sketch or determine a graph that exhibits the qualitative features of a function that has been described.

Objectives: Students will be able to

- Identify polynomial functions and their degree (DOK Level 1)
- Graph polynomial functions using transformations by hand (DOK Level 2)
- Discuss higher order polynomial functions in the graphing calculator and find appropriate viewing windows (DOK Level 2)
- Identify the real zeros of a polynomial function and their multiplicity (DOK Level 1)
- Identify and describe the shape of the graph of a polynomial function near its x-intercepts (DOK Level 2)
- Formulate a sign pattern graph to represent where the graph of a polynomial function is above/below the x-axis (DOK Level 3)
- Graph a polynomial function given its sign pattern graph by hand (DOK Level 2)
- Analyze the graph of a polynomial function (DOK Level 4)
- Find the domain of a rational function (DOK Level 1)
- Find the vertical and horizontal asymptotes of a rational function algebraically (DOK Level 2)
- Analyze the graph of a rational function (DOK Level 3)
- Discuss rational function graphs by using the graphing calculator and find appropriate viewing windows (DOK Level 2)
- Graph rational functions given their sign pattern graph and other information such as vertical/horizontal asymptotes and intercepts by hand (DOK Level 3)
- Interpret limit notation in the context of the features of graphs of rational functions (DOK Level 2)
- Solve polynomial inequalities (DOK Level 2)
- Formulate a sign pattern graph to represent where the graph of a rational function is above/below/on the x-axis (DOK Level 3)
- Solve rational inequalities (DOK Level 2)
- Assess the remainder and factor theorems (DOK Level 3)
- Use the rational zeros theorem to list the potential rational zeros of a polynomial (DOK Level 2)
- Find the real and complex zeros of a polynomial function (DOK Level 3)
- Solve polynomial equations (DOK Level 2)
- Introduce the conjugate pairs theorem (DOK Level 4)
- Construct a polynomial function with specified zeros (DOK Level 3)
- Introduce the Intermediate Value Theorem (DOK Level 3)

Core Activities and Corresponding Instructional Methods:

- Review and enrich students' knowledge on finding the domain and range of a function, identifying even and odd functions, evaluating functions and graphing functions for polynomial and rational models
- Diagnostic assessment, questioning

- Suggested Practice Exercises: Sullivan/Sullivan Precalculus Textbook *Skill Building* - Chapter 4 Sections: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6
- Cooperative learning groups: Graph polynomial and rational functions by hand and identifying properties of such functions
- Direct instruction as needed using Smart Technology in investigating the role of multiplicity, end behavior of a graph and finding zeros of a polynomial function after practicing by pencil-paper without a graphing utility: Sullivan/Sullivan Precalculus Textbook - Pages 186-189
- Direct instruction as needed using Smart Technology in analyzing the graph of rational functions after practicing by pencil-paper without the graphing utility: Sullivan/Sullivan Precalculus Textbook - Pages 235 – 237
- Guided practice using online resources and worksheets

- Integrate academic and content specific vocabulary
  - Suggested Practice Exercises: Sullivan/Sullivan Precalculus Textbook *Concepts and Vocabulary* - Chapter 4 Sections: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6
  - Direct instruction and practice on the various polynomial and rational functions
  - Classroom discussion that prompts students to compare and contrast various properties of polynomial and rational functions using appropriate vocabulary
    - Suggested Application: Chapter Project - *The Length of Day* (Sullivan/Sullivan Precalculus course textbook pages 255-256)
  - Guided practice including step-by-step written/verbal instruction using necessary vocabulary of functions (even, odd, domain, range, compression, stretch, reflection, inverse, one-to-one, multiplicity, end behavior, asymptote, and hole)
  - Utilize the graphing calculators and TI-SmartView to support key vocabulary after students have mastered the graphs of polynomial and rational functions by paper-pencil.
  - Writing activities incorporating appropriate math language
    - Suggested problem sets: Sullivan/Sullivan Precalculus Textbook *Applications and Extensions* - Pages 199-201, 249-250
- Analyze functions and their transformations in the coordinate plane
  - Suggested Activity: Desmos Marbleslides Rationals
    - https://teacher.desmos.com/activitybuilder/custom/566b31794e38e1e21a10aae8?collections=651ca31cf69ee59aa9e3818a%2C5e73b3a1bb8b0c7628d2809c
  - Direct instruction by using visual demonstration of sets of points in the Cartesian coordinate plane by hand and in the TI-84 graphing calculator
  - Classroom discussion by using content specific vocabulary
  - Guided practice on identifying the content through online resources
  - Graphing Utility (TI-SmartView) use to enhance instruction after students have mastered properties and graphs of polynomial and rational functions
- Identify properties of and graph functions

- Direct instruction and classroom discussion about properties: intervals of increase, intervals of decrease; constant intervals; local extrema, asymptotes, holes, end behavior and intercepts supported by visual aids on the Smart Board
- Guided practice: Include step-by-step written/verbal explanation of the behavior of a graph.
- Cooperative group activities
    - Suggested Activity: Desmos Polynomial Equation Challenge
        - https://teacher.desmos.com/activitybuilder/custom/561582ecbd554ea00760f933?collections=651ca31cf69ee59aa9e3818a%2C5e73b275913f047206662889
- Graphing utility practice (TI-SmartView and TI-84 graphing calculators)

- Develop students' ability to solve real world applications by applying their understanding of various functions and their properties
    - Guided practice
    - Cooperative learning groups
        - Suggested Problem Sets: Sullivan/Sullivan Precalculus Textbook *Explaining Concepts: Discussion and Writing* - Pages 199-201, 249-250
    - Step-by-step written/verbal explanation of the behavior of a graph and its application to real world scenarios
    - Graphing utility (TI-SmartView and Ti-84 graphing calculators) exploration

Assessments:

Diagnostic:

- Teacher prepared diagnostic test
- Teacher questioning and observation

Formative:

- Teacher observations, questioning techniques
- Group activities
- Individual, independent quizzes for Chapters 4
- Homework:
    - Example problems from the textbook and online resources for each section (Sullivan/ Sullivan Precalculus Textbook - Sections 4.1, 4.2, 4.3, 4.4, 4.5, 4.6)
    - Teacher made worksheets and applications
    - Khan Academy assignments
    - College Board question banks
    - Online resources such as IXL assignments

Summative:

- Departmental Common Assessment Chapter 4

Unit 3: Exponential and Logarithmic Functions 29 days

Standard(s): Common Core State Standards for Mathematics
http://static.pdesas.org/content/documents/PA%20Core%20Standards%20Mathematics%20PreK-12%20March%202014.pdf

Standards Addressed:

CC.2.1.HS.F.1	CC.2.1.HS.D.7	CC.2.2.HS.C.1	CC.2.2.HS.C.5
CC.2.1.HS.F.3	CC.2.1.HS.D.8	CC.2.2.HS.C.2	CC.2.2.HS.C.6
CC.2.1.HS.D.1	CC.2.1.HS.D.9	CC.2.2.HS.C.3	CC.2.4.HS.B.2
CC.2.1.HS.D.2	CC.2.1.HS.D.10	CC.2.2.HS.C.4	

Anchors:

- M08.B-E.1 Demonstrate an understanding of expressions and equations with radicals and integer exponents.
- M08.B-F.1 Analyze and interpret functions
- M08.B-F.2 Use functions to model relationships between quantities
- A2.1.2.1 Use exponents and logarithms to represent equivalent forms or to solve problems.
- A2.1.2.2 Simplify expressions involving exponents and logarithms.
- A2.2.2.2 Describe and/or determine families of functions.

Eligible Content:

- Apply one or more properties of integer exponents to generate equivalent numerical expressions.
- Use square root and cube root symbols to represent functions.
- Interpret the equation $\mathrm{y} = \mathrm{mx} + \mathrm{b}$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear.
- Compare two different proportional relationships represented in different ways.
- Determine whether a relation is a function.
- Compare properties of two functions represented in different ways (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions).
- Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph.
- Interpret the rate of change and initial value of a function in terms of the situation it models and in terms of its graph or a table of values.
- Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear).
- Sketch or determine a graph that exhibits the qualitative features of a function that has been described.

Objectives: Students will be able to

- Form a composite function (DOK Level 1)
- Find the domain of a composite function (DOK Level 1)

- Determine whether a function is one-to-one (DOK Level 1)
- Determine the inverse of a function defined by a map on or a set of ordered pairs (DOK Level 1)
- Determine the inverse of a function defined by an equation algebraically (DOK Level 2)
- Obtain the graph of the inverse function from the graph of a function (DOK Level 2)
- Evaluate exponential functions (DOK Level 2)
- Graph exponential functions (DOK Level 2)
- Define the number e (DOK Level 1)
- Compare linear and exponential models (DOK 3)
- Solve exponential equations (DOK Level 3)
- Change exponential expressions to logarithmic expressions and logarithmic expressions to exponential expressions (DOK Level 2)
- Evaluate logarithmic expressions (DOK Level 2)
- Determine the domain of a logarithmic function (DOK Level 2)
- Graph logarithmic functions (DOK Level 2)
- Solve logarithmic equations (DOK Level 3)
- Work with the properties of logarithms (DOK Level 3)
- Write a logarithmic expression as a sum or difference of logarithms (DOK Level 3)
- Write a logarithmic expression as a single logarithm (DOK Level 3)
- Evaluate logarithms whose base is neither 10 nor e (DOK Level 3)
- Graph a logarithmic function whose base is neither 10 nor e (DOK Level 3)
- Analyze financial modeling problems (DOK Level 4)
- Analyze exponential growth and decay models (DOK Level 4)

Core Activities and Corresponding Instructional Methods:

- Review and enrich students' knowledge on finding the domain and range of a function, identifying even and odd functions, evaluating functions, and graphing functions for exponential and logarithmic models.
    - Diagnostic assessment, questioning
    - Cooperative learning groups
    - Direct instruction as needed using Smart Technology
    - Guided practice using online resources and worksheets
    - Suggested Practice Exercises: Sullivan/Sullivan Precalculus Textbook *Skill Building* - Chapter 5 Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8
- Integrate academic and content specific vocabulary
    - Suggested Practice Exercise: Sullivan/Sullivan Precalculus Textbook *Concepts and Vocabulary* - Chapter 5 Sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8
    - Direct instruction and practice on the various exponential and logarithmic functions
    - Classroom discussion that prompts students to compare and contrast various properties of functions using appropriate vocabulary

        - Suggested Application: Chapter Project *Depreciation of Cars* (Sullivan/Sullivan Precalculus Textbook - Page 361)
    - Guided practice including step-by-step written/verbal instruction using necessary vocabulary of functions (even, odd, domain, range, compression, stretch, reflection, inverse, one-to-one)
    - Utilize the graphing calculators and TI-SmartView to support key vocabulary
    - Writing activities incorporating appropriate math language
        - Suggestion Writing: Sullivan/Sullivan Precalculus Textbook *Explaining Concepts: Discussion and Writing* - Pages 278, 308, and 324
- Analyze functions and their transformations in the coordinate plane
    - Direct instruction by using visual demonstration of sets of points in the Cartesian coordinate plane by hand and in the TI-84 graphing calculator
    - Classroom discussion by using content specific vocabulary of stretches, compressions, translations
        - Suggested Activity: Desmos *Card Sort Exponentials*
            - https://teacher.desmos.com/activitybuilder/custom/579bd9fe3037419e171c207d?collections=651ca31cf69ee59aa9e3818a%2C5da6462c8b305273be677729
    - Guided practice on identifying the content through online resources
    - Graphing Utility (TI-SmartView) use to enhance instruction
        - Suggested Enrichment Activity: *Building Exponential, Logarithmic, and Logistic Models from Data* - Section 5.9 of Sullivan/Sullivan Precalculus Textbook
- Identify properties of and graph functions
    - Direct instruction and classroom discussion about properties: intervals of increase, intervals of decrease; constant intervals; local extrema, asymptotes, and intercepts supported by visual aids on the Smart Board
    - Guided practice: Include step-by-step written/verbal explanation of the behavior of a graph
    - Cooperative group activities
        - Suggested Enrichment and Extension: Students work collaboratively on application and extensions of exponential and logistic growth and decay models (Section 5.7-5.8 of Sullivan/Sullivan Precalculus Textbook)
        - Suggested Activity: Think, Pair, Share Activity - Students create their own exponential and logarithmic models and share with each other in collaborative settings.
    - Graphing utility practice (TI-SmartView and TI-84 graphing calculators)
- Develop students' ability to solve real world applications by applying their understanding of various functions and their properties
    - Guided practice
    - Cooperative learning groups

- Students create their own exponential and logarithmic scenarios using *Applications and Extensions* found in Sullivan/Sullivan Precalculus Textbook - Pages 332-333, 342-345
- Step-by-step written/verbal explanation of the behavior of a graph
- Graphing utility (TI-SmartView and Ti-84 graphing calculators) use for exploration.

Assessments:

Diagnostic:

- Teacher prepared diagnostic test
- Teacher questioning and observation

Formative:

- Teacher observations, questioning techniques
- Group activities
- Individual, independent quizzes for Chapters 5
- Homework:
    - Example problems from the textbook and online resources for each section (Sullivan/Sullivan Textbook - Sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8)
    - Teacher made worksheets and applications
    - Khan Academy assignments
    - College Board question banks
    - Online resources such as IXL assignments

Summative:

- Departmental Common Assessment Chapter Exam 5

Unit 4: Trigonometric Functions 60 days

Standard(s): Common Core State Standards for Mathematics
http://static.pdesas.org/content/documents/PA%20Core%20Standards%20Mathematics%20PreK-12%20March%202014.pdf

Standards Addressed:

CC.2.1.HS.F.1	CC.2.1.HS.D.5	CC.2.2.HS.C.3	CC.2.2.HS.C.9
CC.2.1.HS.F.3	CC.2.1.HS.D.9	CC.2.2.HS.C.4	CC.2.3.HS.A.1
CC.2.1.HS.D.1	CC.2.2.HS.C.1	CC.2.2.HS.C.7	CC.2.3.HS.A.7
CC.2.1.HS.D.2	CC.2.2.HS.C.2	CC.2.2.HS.C.8	CC.2.3.HS.A.10

Anchors:

- M08.B-E.1 Demonstrate an understanding of expressions and equations with radicals and integer exponents.
- M08.B-F.1 Analyze and interpret functions.
- M08.B-F.2 Use functions to model relationships between quantities.
- A2.1.2.1 Use trigonometry to represent equivalent forms or to solve problems.
- A2.1.2.2 Simplify expressions involving trigonometry.

Eligible Content:

- Use square root symbols to represent functions.
- Compare two different proportional relationships represented in different ways.
- Determine whether a relation is a function.
- Compare properties of two functions represented in different ways (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions).
- Determine the values of the function including reading these from a table or from a graph.
- Interpret values of a function in terms of the situation it models and in terms of its graph or a table of values.

Objectives: Students will be able to

- Convert between decimals and degrees, minutes, seconds for angles (DOK Level 2)
- Find the arc length of a circle (DOK Level 2)
- Convert from degrees to radians and radians to degrees (DOK Level 1)
- Find the area of a sector of a circle (DOK Level 2)
- Find, by hand, the exact values of all the trigonometric functions using a point on the unit circle (DOK Level 2)
- Find, by hand, the exact values of all the trigonometric functions of the quadrantal angles (DOK Level 2)
- Find, by hand, the exact values of the exact values of the trigonometric functions for integer multiples of $\frac{\pi}{6} = 30°$, $\frac{\pi}{4} = 45°$, and $\frac{\pi}{3} = 60°$ (DOK Level 2)
- Use a calculator to approximate the value of the trigonometric function off the unit circle (DOK Level 1)
- Use circle of radius r to evaluate the trigonometric functions (DOK Level 3)

- Determine the domain and range of the trigonometric functions (DOK Level 2)
- Determine the period of the trigonometric functions (DOK Level 2)
- Determine the signs of the trigonometric functions in a given quadrant (DOK Level 1)
- Find the values of the trigonometric functions using fundamental identities (DOK Level 3)
- Find the exact values of the trigonometric functions of an angle given one of the functions and the quadrant of the angle (DOK Level 3)
- Graph functions in the form of $y = A\cos(\omega\theta)$ and $y = A\sin(\omega\theta)$ using transformations (DOK Level 4)
- Determine the amplitude and period of sinusoidal functions (DOK Level 2)
- Graph sinusoidal functions using key points (DOK Level 3)
- Find an equation for a sinusoidal graph (DOK Level 3)
- Graph sinusoidal functions of the form $y = A\cos(\omega\theta - \varphi) + B$ and $y = A\sin(\omega\theta - \varphi) + B$ (DOK Level 4)
- Apply trigonometric functions to real world problems (DOK Level 4)
- Find the exact value of inverse sine, cosine, and tangent functions (DOK Level 3)
- Use properties of inverse functions to find exact values of certain composite functions (DOK Level 4)
- Find the inverse function of a trigonometric function (DOK Level 3)
- Solve equations using inverse trigonometric functions (DOK Level 3)
- Write a trigonometric expression as an algebraic expression (DOK Level 3)
- Use algebra to simplify trigonometric expressions (DOK Level 3)
- Establish fundamental trigonometric identities (reciprocal, Pythagorean and quotient) (DOK Level 4)
- Use sum and difference formulas to find exact values and establish identities (DOK Level 3)
- Solve equations involving a single trigonometric function (DOK Level 3)
- Solve trigonometric equations quadratic and linear in form (DOK Level 3)
- Solve trigonometric equations using identities (DOK Level 4)
- Find the value of trigonometric functions of an acute angle using right triangles (DOK Level 3)
- Solve right triangles (DOK Level 3)
- Solve applied problems using right triangles (DOK Level 4)
- Solve SAA, ASA, and SSA triangles using the Law of Sines (DOK Level 3)
- Solve ASA and SSS triangles using the Law of Cosines (DOK Level 3)
- Use the Law of Sines and the Law of Cosines to solve applied problems (DOK Level 3)
- Find the area of SSS triangles using Heron's Formula (DOK Level 2)
- Find the area of SAS triangles using the lengths of two sides and the sine of the included angle (DOK Level 2)

Core Activities and Corresponding Instructional Methods:

- Review students' prior knowledge on finding the domain and range of a function, identifying even and odd functions, evaluating functions
    - Diagnostic assessment, questioning
    - Cooperative learning groups
    - Direct instruction as needed using Smart Technology
    - Guided practice using online resources and worksheets
    - Suggested Practice Exercises: Sullivan/Sullivan Precalculus Textbook *Skill Building* - Sections: 6.1, 6.4, 7.1, 7.2, 7.3, 7.5, 8.1, 8.2, 8.3
- Integrate academic and content specific vocabulary
    - Suggested Practice Exercise: Sullivan/Sullivan Precalculus Textbook *Concepts and Vocabulary* - *S*ections: 6.1, 6.4, 7.1, 7.2, 7.3, 7.5, 8.1, 8.2, 8.3
    - Direct instruction and practice on the various trigonometric functions
    - Classroom discussion that prompts students to compare and contrast various properties of functions using appropriate vocabulary
        - Suggested Application: Chapter Projects
            - *Length of Day* (Sullivan/Sullivan Precalculus Textbook - Page 450)
            - *Mapping Your Mind* (Sullivan/Sullivan Precalculus Textbook - Page 521)
    - Guided practice including step-by-step written/verbal instruction using necessary vocabulary of functions (even, odd, domain, range, compression, stretch, reflection, inverse, one-to-one)
    - Utilize the graphing calculators and TI-SmartView to support key vocabulary
        - Suggested Enrichment Activities: Sullivan/Sullivan Precalculus Textbook
            - Section 6.6: *Finding a Sinusoidal Function for Hours of Daylight* and *Finding the Sine Function of Best Fit*
            - Section 7.2: *Angle of Repose: Bunker Sand*
            - Section 8.1: *Solve Applied Problems*
    - Writing activities incorporating appropriate math language
        - Suggestion Writing: Sullivan/Sullivan Precalculus Textbook *Explaining Concepts: Discussion and Writing* - Pages 393, 423, 482, and 535
- Analyze functions and their transformations in the coordinate plane
    - Direct instruction by using visual demonstration of sets of points in the Cartesian coordinate plane by hand and in the TI-84 graphing calculator
    - Classroom discussion by using content specific vocabulary
        - Suggested Activity: Desmos *Marbleslides: Periodics*
            - https://teacher.desmos.com/activitybuilder/custom/566b317d4e38e1e21a10ab07?collections=651ca31cf69ee59aa9e3818a%2C5e73b275913f047206662889
    - Guided practice on identifying the content through online resources
    - Use Graphing Utility (TI-SmartView) to enhance instruction
        - Suggested Problems from Sullivan/Sullivan Precalculus Textbook:

- "Bridge Clearance" (Page 422)
- "Carrying a Ladder" and "Rotating Beacon (Page 430)
- "Finding the Distance Across a Pond" (Page 532)
- "Parallax" (Page 533)

- Identify properties of and graph functions
  - Direct instruction and classroom discussion about properties: intervals of increase, intervals of decrease; constant intervals; local extrema, asymptotes, and intercepts supported by visual aids on the Smart Board
  - Guided practice: Include step-by-step written/verbal explanation of the behavior of a graph
  - Cooperative group activities
    - Suggested Activity: Desmos *Burning Daylight*
      - https://teacher.desmos.com/activitybuilder/custom/56d8aee5637a85a2078c257d?collections=651ca31cf69ee59aa9e3818a%2C5e73b36a5141777627553357
  - Graphing utility practice (TI-SmartView and TI-84 graphing calculators)
- Develop students' ability to solve real world applications by applying their understanding of various functions and their properties
  - Guided practice
  - Cooperative learning groups
    - Students create their own trigonometric scenarios using Applications and Extensions found in Sullivan/Sullivan Precalculus Textbook - Pages 421-422, 464-465, and 532-535
  - Step-by-step written/verbal explanation of the behavior of a graph
  - Graphing utility (TI-SmartView and Ti-84 graphing calculators)

Assessments:

Diagnostic:

- Teacher prepared diagnostic test
- Teacher questioning and observation

Formative:

- Teacher observations, questioning techniques
- Group activities
- Individual, independent quizzes for Chapters 6, 7, and 8
- Homework:
  - Example problems from the textbook and online resources for each section (Sullivan/ Sullivan Textbook - Sections 6.1–6.4, 7.1–7.4, and 8.1–8.4)
  - Teacher made worksheets and applications
  - Khan Academy assignments
  - College Board question banks
  - Online resources such as IXL assignments

Summative:

- Departmental Common Assessment Chapters 6 and 7

Unit 5: Analytic Geometry (EXTENSION) **Marking Period:** 4

Suggested Activities for after the Final Exam

Systems of Equations, Polar and Parametric Graphs, Introduction to Limits, Sequences and Series

Standard(s): Common Core State Standards for Mathematics
http://static.pdesas.org/content/documents/PA%20Core%20Standards%20Mathematics%20PreK-12%20March%202014.pdf

Standards Addressed:

CC.2.1.HS.F.3	CC.2.1.HS.D.5	CC.2.1.HS.D.10	CC.2.2.HS.C.4
CC.2.1.HS.D.1	CC.2.1.HS.D.7	CC.2.2.HS.C.1	CC.2.3.HS.A.1
CC.2.1.HS.D.2	CC.2.1.HS.D.8	CC.2.2.HS.C.2	CC.2.3.HS.A.10
CC.2.1.HS.D.3	CC.2.1.HS.D.9	CC.2.2.HS.C.3	

Anchors:

- M08.B-E.1 Demonstrate an understanding of expressions and equations with radicals and integer exponents.
- M08.B-F.1 Analyze and interpret functions
- M08.B-F.2 Use functions to model relationships between quantities
- A2.1.2.1 Use equivalent forms to solve problems.
- A2.1.2.2 Simplify expressions involving analytical geometry

Eligible Content:

- Compare two different proportional relationships represented in different ways.
- Determine whether a relation is a function.
- Compare properties of two functions represented in different ways (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions).
- Determine the values of the function including reading these from a table or from a graph.
- Interpret values of a function in terms of the situation it models and in terms of its graph or a table of values.

Objectives: Students will be able to

- Convert from rectangular to polar coordinates and vice versa. (DOK Level 1)
- Transform equations between polar and rectangular forms. (DOK Level 2)
- Graphing polar equations by using a graphing utility. (DOK Level 2)
- Graphing parametric equations by using a graphing utility. (DOK Level 2)
- Find the limit using a table, graph, or an equation. (DOK Level 2).
- Find a one-sided limit by looking at a graph. (DOK Level 1).
- Recall the names of the four conics. (DOK Level 1)
- Identify the equations in standard form for each of the four conics. (DOK Level 1)
- Analyze parabolas with vertex at both the origin and the point (h, k). (DOK Level 3)

- Analyze ellipses with vertex at both the origin and the point (h, k). (DOK Level 4)
- Analyze hyperbolas with vertex at both the origin and the point (h, k). (DOK Level 4)
- Analyze circles with vertex at both the origin and the point (h, k). (DOK Level 3)
- Write the standard form for the equation of a circle. (DOK Level 2)
- Graph a circle both with the center at and off of the origin. (DOK Level 2)
- Construct the general form for the equation of a circle. (DOK Level 2)
- Solve systems of linear and nonlinear equations using both elimination and substitution. (DOK Level 2)
- Identify consistent and inconsistent systems of equations containing two and three variables. (DOK Level 1)
- Solve systems of three equations containing three variables. (DOK Level 2)
- Express the solution of systems of dependent equations containing two and three variables. (DOK Level 2)
- Write the first several terms of a sequence. (DOK Level 1 and 2)
- Write the terms of a sequence defined by a recursive formula. (DOK 3)
- Use summation notation. (DOK Level 2 and 3).

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
    - Suggested Practice Exercise: Sullivan/Sullivan Precalculus Textbook *Concepts and Vocabulary* - *S*ections 9.1, 9.2, 10.6, 10.7, 11.1, 11.2, 11.3, 12.1, 12.2, and 12.3
    - Direct instruction and practice
    - Lead a classroom discussion that prompts students to compare and contrast
        - Suggested Application: Chapter Projects
            - *Modeling Airport Motion* (Sullivan/Sullivan Precalculus Textbook - Page 652)
            - *Comet Hale-Bopp* (Sullivan/Sullivan Precalculus Textbook – Page 722)
            - *Markov Chains* (Sullivan/Sullivan Precalculus Textbook - Page 822)
    - Guided practice: Include step-by-step written explanation of solutions to open-ended questions
    - Build background knowledge by utilizing a graphing utility and TI-SmartView to support solutions to questions and problems
        - Suggested Enrichment Activities: Sullivan/Sullivan Precalculus Textbook
            - Section 10.7: *Orbit of Mercury*
            - Section 11.6: *Solving a System of Nonlinear Equations*
- Analyze functions
    - Direct instruction by using visual demonstration
    - Classroom discussion by using content specific vocabulary

- Suggested Practice Exercise: Sullivan/Sullivan Precalculus Textbook *Concepts and Vocabulary - S*ections 9.1, 9.2, 10.6, 10.7, 11.1, 11.2, 11.3, 12.1, 12.2, and 12.3
- Guided practice on identifying the content specific vocabulary.
- Graphing utility (TI-SmartView)
  - Suggested Enrichment Activities: Sullivan/Sullivan Precalculus Textbook
    - Section 9.2: *Graphing Polar Equations: Cardioid, Limacon, Rose, Lemniscate, and Spiral*

- Identify properties of and graph functions
  - Direct instruction and classroom discussion about properties supported by visual aids on the SmartBoard
  - Guided practice: Include step-by-step written explanation of the behavior of a graph
  - Graphing utility (TI-SmartView)
    - Suggested Enrichment Activities: Sullivan/Sullivan Precalculus Textbook
      - Section 9.2: *Graphing Polar Equations: Cardioid, Limacon, Rose, Lemniscate, and Spiral*
- Analyze examples of applications of functions
  - Classroom discussion and guided practice on building models from analyzing data in a real-world situation.
    - Suggested Practice Exercise: Sullivan/Sullivan Precalculus Textbook *Applications and Extensions - Sections 10.4*, 10.7, 11.6, and 12.3
  - Develop both a verbal and/or written logical argument to support conclusions about behaviors of graphs.
    - Suggested Practice Exercise: Sullivan/Sullivan Precalculus Textbook *Explaining Concepts: Discussion and Writing - S*ections 9.3, 10.7, 11.6, and 12.3
  - Determine appropriate window to view the graph of any given function
  - Graphing utility (TI-SmartView)
    - Suggested enrichment activities: Sullivan/Sullivan Precalculus Textbook
      - Section 9.2: *Graphing Polar Equations: Cardioid, Limacon, Rose, Lemniscate, and Spiral*

Assessments:

Diagnostic:

- Teacher prepared diagnostic test
- Teacher questioning and observation

Formative:

- Teacher observations, questioning techniques
- Group activities
- Individual, independent quizzes for Chapters 9, 10, 11, and 12
- Homework:

- Example problems from the textbook and online resources for each section (Sullivan/ Sullivan Textbook Chapters 9, 10, 11, and 12)
- Teacher made worksheets and applications
- Online resources such as IXL assignments