Southern York County School District Instructional Plan

Course/Subject: Calculus

Grade Level: 11,12

Textbook(s)/Instructional Materials Used: College Preparatory Mathematics Calculus; ISBN 1-931287-29-5; Copyright 2003 by College Preparatory Math Educational Program

Month(s): August/September	**Unit Plan 1**

Stage 1 – Desired Results

PA Core Standard(s)/Assessment Anchors Addressed:

- **CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.**
- **CC.2.2.HS.D.10 Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.**
- **CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.**
- **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.**
- **CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.**
- **CC.2.2.HS.C.4 Interpret the effects transformations have on functions and find the inverses of functions.**
- **CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.**
- **CC.2.3.HS.A.12 Explain volume formulas and use them to solve problems.**
- **CC.2.3.HS.A.13 Analyze relationships between two-dimensional and three-dimensional objects.**
- **CC.2.3.HS.A.14 Apply geometric concepts to model and solve real world problems.**

Understanding(s): ***Students will understand . . .***	**Essential Question(s):**
1. Transformations will work in a variety of functions and non-functions (CC.2.2.HS.C.1, CC.2.2.HS.C.4) 2. Volume and area can be used to explore 2 and 3 dimensional shapes (CC.2.3.HS.A.12, CC.2.3.HS.A.13, CC.2.3.HS.A.14) 3. Functions have a rate of change that may or may not be noticeable (CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6)	▪ How area volume and area used to expand our knowledge of the world ▪ To what extent does a transformation affect a function or non-function ▪ To what extent can change go unnoticed
Learning Objectives:	

Students will know . . . ▪ How to transform a variety of functions and non-functions (CC.2.2.HS.C.1, CC.2.2.HS.C.4) ▪ How to use area and volume formulas in new ways (CC.2.3.HS.A.12, CC.2.3.HS.A.13, CC.2.3.HS.A.14) ▪ How some function change (CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6)	***Students will be able to:*** ▪ Discern some patterns of change among certain functions ▪ Find the minimum or a maximum of a curve or real life situation ▪ Use shifts to create graphs
Month(s): September/October	**Unit Plan 2**
Stage 1 – Desired Results	
PA Core Standard(s)/Assessment Anchors Addressed: ▪ **CC.2.2.HS.D.6 Extend the knowledge of rational functions to rewrite in equivalent forms.** ▪ **CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.** ▪ **CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.** ▪ **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.** ▪ **CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.** ▪ **CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.**	
Understanding(s): ***Students will understand . . .*** 1. Functions have different end behavior and asymptotes (CC.2.2.HS.D.6, CC.2.2.HS.D.7, CC.2.2.HS.C.1, CC.2.2.HS.C.2) 2. Functions have different slopes at different points on the graph (CC.2.2.HS.C.1, CC.2.2.HS.C.2) 3. Distance and velocity are all interconnected ideas (CC.2.2.HS.C.1, CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6)	**Essential Question(s):** ▪ To what extent are functions the same or different ▪ What is the relationship between distance, velocity, and acceleration
Learning Objectives: ***Students will know . . .*** ▪ How to explore functions (CC.2.2.HS.D.6, CC.2.2.HS.D.7, CC.2.2.HS.C.1, CC.2.2.HS.C.2) ▪ How to describe slope on a function (CC.2.2.HS.C.1, CC.2.2.HS.C.2) ▪ How to describe the relationship between distance and velocity (CC.2.2.HS.C.1, CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6)	***Students will be able to:*** ▪ Extend their understanding of function end behavior ▪ Compare and contrast the local and global behavior of a function ▪ Review and extend their understanding of graphs that have holes and asymptotes ▪ Investigate inverse and composite functions ▪ Recognize the relationship between distance and velocity

Month(s): October/November	Unit Plan 3
Stage 1 – Desired Results	
PA Core Standard(s)/Assessment Anchors Addressed: ▪ **CC.2.2.HS.D.1 Interpret the structure of expressions to represent a quantity in terms of its context.** ▪ **CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.** ▪ **CC.2.2.HS.D.10 Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.** ▪ **CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.** ▪ **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.** ▪ **CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.** ▪ **CC.2.3.HS.A.12 Explain volume formulas and use them to solve problems.**	
Understanding(s): ***Students will understand . . .*** 1. Area under a curve can be estimated in a summation approach (CC.2.2.HS.D.2, CC.2.3.HS.A.12) 2. Limits represent end behavior of a function at a specific point (CC.2.2.HS.D.10, CC.2.2.HS.C.1, CC.2.2.HS.C.2, CC.2.2.HS.C.6)	**Essential Question(s):** ▪ To what extent is area under the curve significant?
Learning Objectives: ***Students will know . . .*** ▪ How to calculate area in a more accurate way (CC.2.2.HS.D.2, CC.2.3.HS.A.12) ▪ How to evaluate and write Riemann Sums (CC.2.2.HS.D.1, CC.2.2.HS.D.2, CC.2.3.HS.A.12) ▪ How to compute the limits of functions (CC.2.2.HS.D.10, CC.2.2.HS.C.1, CC.2.2.HS.C.2, CC.2.2.HS.C.6)	***Students will be able to:*** ▪ Approximate the area under a curve using a Riemann Sum and summation notation ▪ Predict function behavior with the notion of limits ▪ Strengthen their intuitive understanding of continuity ▪ Understand how continuity provides the basis for the Intermediate Value Theorem
Month(s): December	**Unit Plan 4**
Stage 1 – Desired Results	
PA Core Standard(s)/Assessment Anchors Addressed: ▪ **CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.** ▪ **CC.2.2.HS.D.10 Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.** ▪ **CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.** ▪ **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.**	
Understanding(s):	**Essential Question(s):**

Students will understand . . . 1. The first and second derivative of a function plays an important role in curve analysis 2. The first derivative shows the possible minimum and maximum values as well as if the function is increasing or decreasing 3. The second derivative shows the possible point of inflection and concavity of a function	▪ What roles do the first and second derivative play in curve analysis?
Learning Objectives: ***Students will know . . .*** ▪ How to find the derivative of a given function (CC.2.2.HS.D10, CC.2.2.HS.C1) ▪ How to find the second derivative of a given function (CC.2.2.HS.D10, CC.2.2.HS.C1) ▪ How to find the shape of a function using the information from the derivatives (CC.2.2.HS.D7, CC.2.2.HS.C2)	***Students will be able to:*** ▪ Find the slope functions for most parent graphs analytically and graphically ▪ Derive and use the formal definition of a derivative as the limit of the slope of a tangent line ▪ Derive methods to quickly find the derivatives of sine, cosine, and power functions ▪ Discover the role of the second derivative to describe a function's shape, increasing/decreasing, and concavity ▪ See the relationship between derivatives and other rates of change such as velocity and acceleration ▪ Investigate and categorize functions which are not differentiable everywhere
Month(s): January/February	**Unit Plan 5**
Stage 1 – Desired Results	
PA Core Standard(s)/Assessment Anchors Addressed: ▪ **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.** ▪ **CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.** ▪ **CC.2.3 HS.A.13 Analyze relationships between two-dimensional and three-dimensional objects.** ▪ **CC.2.3 HS.A. Apply geometric concepts to model and solve real world problems.**	
Understanding(s): ***Students will understand . . .*** 1. The area under a curve can be exactly calculated using integration (CC.2.2.HS.C.2 2. Indefinite Integrals define the function and definite integrals determine the exact area (CC.2.2.HS.C.6	**Essential Question(s):** ▪ How is the Fundamental Theorem of Calculus related to area under a curve ▪ How can I use geometry to calculate area ▪ How can I use Calculus to calculate the area
Learning Objectives:	

Students will know . . .	***Students will be able to:***
▪ How to set up an integral to find area under a curve (CC.2.2.HS.C.6) ▪ How to use the Fundamental Theorem of Calculus (CC.2.2.HS.C.2) ▪ How to find area between two curves (CC.2.3.HS.A.13, CC.2.3.HS.A.14)	▪ Set up and evaluate an integral to find exact area under a curve ▪ Create area functions to find the area under a curve between a fixed endpoint and a variable endpoint ▪ Investigate the properties of definite integrals ▪ Discover the Fundamental Theorem of Calculus and use it to evaluate a definite integral ▪ Calculate the area of a region determined by multiple curves

Month(s): February/March	**Unit Plan 6**

Stage 1 – Desired Results

PA Core Standard(s)/Assessment Anchors Addressed:

- **CC.2.1.HS.F.3 Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.**
- **CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.**
- **CC.2.2.HS.D.9 Use reasoning to solve equations and justify the solution method.**
- **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.**
- **CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.**
- **CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.**
- **CC.2.2.HS.C.8 Choose trigonometric functions to model periodic phenomena and describe the properties of the graphs.**

Understanding(s): ***Students will understand . . .***	**Essential Question(s):**
1. Distance, velocity, and acceleration are interconnected by differentiation and integration (CC.2.1.HS.F.3, CC.2.2.HS.D.7, CC.2.2.HS.D.9, CC.2.2.HS.C.3, CC.2.2.HS.C.6) 2. The first derivative will tell you about the minimum or maximum of the original function(CC.2.2.HS.D.7, CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6)	▪ How are the concepts of distance, velocity, and acceleration interconnected? ▪ How can I apply the power rule, chain rule, and quotient rule to various functions? ▪ How are Calculus concepts related to Physics?
Learning Objectives:	

Students will know . . . ▪ How to use a model to represent distance, velocity, and acceleration (CC.2.1.HS.F.3, CC.2.2.HS.D.7, CC.2.2.HS.D.9, CC.2.2.HS.C.6) ▪ How to find the minimum and maximum (CC.2.2.HS.D.7, CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6) ▪ How and when to use the power rule, chain rule, and quotient rule (CC.2.2.HS.C.2) • How to take the derivative of a trig function (CC.2.2.HS.C.8)	***Students will be able to:*** ▪ Define functions to model quantities such as velocity, acceleration, distance, volume, profit, cost, time, and area ▪ Distinguish between a maximum and a minimum using the first and second derivatives ▪ Clarify and categorize the different types of extreme values of a function ▪ Develop more techniques for derivatives: the power rule, chain rule and quotient rule ▪ Discover the derivatives of secant, cosecant, tangent and cotangent
Month(s): March/April	**Unit Plan 7**

Stage 1 – Desired Results	
PA Core Standard(s)/Assessment Anchors Addressed: ▪ **CC.2.1.HS.F.2 Apply properties of rational and irrational numbers to solve real world or mathematical problems.** ▪ **CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.** ▪ **CC.2.2.HS.C.2 Graph and analyze functions and use their properties to make connections between the different representations.** ▪ **CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.** ▪ **CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.**	
Understanding(s): ***Students will understand . . .*** 1. Implicit Differentiation will allow you to determine the derivatives on non-functions (CC.2.2.HS.D.2) 2. The mathematical constant e has many applications including instantaneous compounding interest and natural logarithms (CC.2.1.HS.F.2)	**Essential Question(s):** ▪ How can implicit differentiation help you to find the derivatives of non-functions? ▪ Where does the mathematical constant e occur in real life situations?
Learning Objectives: ***Students will know . . .*** ▪ How to find the derivative of an exponential function (CC.2.1.HS.F.2) ▪ How to use implicit differentiation (CC.2.2.HS.D.2) ▪ How to find the derivatives of all the parent graphs (CC.2.2.HS.C.2, CC.2.2.HS.C.3, CC.2.2.HS.C.6)	***Students will be able to:*** ▪ Revisit exponential functions and find their derivatives ▪ Explore the mathematical constant e ▪ Expand their knowledge of derivatives to include implicit differentiation ▪ Complete all the remaining derivatives of the parent graphs
Month(s): May/June	**Unit Plan 8**

Stage 1 – Desired Results
PA Core Standard(s)/Assessment Anchors Addressed: ▪ **CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.**

<table>
<tr><td colspan="2">▪ CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.</td></tr>
<tr><td>Understanding(s):
Students will understand . . .
1. Substitution is a powerful tool to take the integral of many functions (CC.2.2.HS.D.2)
2. Rates of change mirror real world examples of Calculus (CC.2.1.HS.F.4, CC.2.2.HS.D.2</td><td>Essential Question(s):

▪ How do rates of change apply to everyday situations?
▪ How can substitution method help me take the integral of functions that were not possible before?</td></tr>
<tr><td>Learning Objectives:
Students will know . . .
▪ How to use the substitution method for integration (CC.2.2.HS.D.2)
▪ How to use and work with related rates of change (CC.2.1.HS.F.4, CC.2.2.HS.D.2</td><td>
Students will be able to:
▪ Describe the relationship between rates of change for different scenarios
▪ Complete their integration methods with the substitution method
▪ Solve for a rate of change given another rate of change</td></tr>
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