Abington Heights School District
Calculus Curriculum

In Calculus, students develop their numeracy skills through the following areas of study:

1. Limits and Continuity
2. Derivatives
3. Applications of Derivatives
4. Analyzing Functions
5. Integrals

Board Approval Date: June 7, 2023
Adoption: 2023 - 2024 SY
Review Date:

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

AH MATHEMATICS

Where collaborative problem solving and perseverance lead to excellence

Abington Heights Math Framework

Stakeholders	Actions
Students	★ Engage in mathematical discussions, share their ideas openly, be inquisitive, seek to understand and learn more about mathematical concepts, and try their best daily. ★ Exhibit creativity and curiosity in problem solving individually and collaboratively. ★ Persevere in engaging and challenging daily mathematical practice. ★ Come prepared to learn every day.
Teachers	★ Create a safe and collaborative classroom environment where students feel vested in a shared vision for mathematical excellence. ★ Develop high quality instruction that meets the needs of all learners through differentiation. ★ Use a variety of 21st century methodologies to advance learning. ★ Partner with parents and guardians to support student success. ★ Establish a collaborative community within the building and amongst grade levels to ensure a cohesive level of instruction.
Building Leaders	★ Deeply understand the needs of teachers, students, the instructional materials being used, programs being implemented, and the expectations for state-level assessment scores ○ Knowledgeable about program and grade level standards ○ Ensure consistent and equal access to high-quality instructional materials and resources, building. ★ Be partners with teachers, students and families: ○ Provide guidance and support to the mathematical community. ○ Understand needs of teachers, students and families. ★ Trust the educators to make professional decisions based on program, student, and district needs.
Central Admin	★ Effectively communicate to the school board and community specific areas of need and how to support teachers and building leaders in a quest for mathematical excellence ★ Deeply understand the needs of teachers, students, the instructional materials being used, programs being implemented, and the expectations for state-level assessment scores ○ Have a common metric for mathematical excellence. ○ Ensure consistent and equal access to high-quality instructional materials and resources, district. ○ Re-examine best practices/curriculum routinely (6 years). ★ Support a culture of collaboration between the other stakeholder groups to maintain the standard of excellence of the Abington Heights ★ Trust the educators to make professional decisions based on program, student, and district needs.
Parents/ Community	★ Be a strong support system and contribute by building a positive math community for students. ★ Encourage a positive math mindset. ★ Have conversations with their children about school and ask what they are learning about in school. ★ Be open, receptive to the district's ideas about student learning and reach out to teachers/school to learn more about how they can support. ★ Trust the educators to make professional decisions based on program, student, and district needs.
School Board	★ Provide the fiscal resources to support: ○ Highly qualified professionals for mathematics ○ High-quality instructional materials ○ Effective and efficient math interventions for remediation ○ Professional development for math content and instructional practices ★ Trust the educators to make professional decisions based on program, student, and district needs.

Calculus Scope and Sequence

Month	Unit	Estimated Number of Weeks
September	Functions	2
September - October	Limits	2
October	Definition of Derivative	2
November - December	Derivative Rules	6
December - January	Implicit & Higher Order Differentiation	3
February	Related Rates	3
March	Logarithms & Logarithmic Differentiation	2
March	Optimization	2
April	Curve Sketching	3
April - May	Indefinite Integration	4
	Definite Integration & Mean Value Theorem	2
June	Final Exam Review	1

Unit	Essential Questions	Content	Skills	Activities	Assessment / Evidence of Learning
Functions	What does the notation f(x) mean and how can it be manipulated? How are functions added, subtracted, multiplied, divided, and composed?	Function manipulation	Compose functions Factoring sum and difference of cubes Interpret function notation Utilize algebraic skills to add, subtract, multiply and divide functions	Function Manipulation Flip Chart 1 and 2 Group Practice Set Class Discussions Homework sets	Group Practice Set Functions Quiz
Limits	What is a limit? How can limits be evaluated using a graph? How can limits be evaluated algebraically?	Graphical Evaluation of Limits Algebraic Evaluation of Limits	Simplifying complex fractions to evaluate a limit Simplifying radical expressions to evaluate a limit Substituting to evaluate a limit. Factoring rational expressions to evaluate a limit Analyzing a graph to determine limits Analyzing a graph to determine one-sided limits	Introduction to Limits Flip Chart Algebraic Evaluation of Limits Flip Chart Graphical Evaluation of Limits Flip Chart Limits WeBWork Class Discussions Homework sets	Limits WeBWork Limits Quiz

Unit	Essential Questions	Content	Skills	Activities	Assessment / Evidence of Learning
Definition of Derivative	What is a derivative? How can one determine a derivative? What is a derivative used for? What is a difference quotient? What does it represent and how is this connected to the idea of a derivative? Looking at a graph, what can reasonably be determined about the value of a derivative at a give x-value?	Algebraic definition of derivative Conceptual definition of derivative Power Rule Application of derivative Notation	Estimate the value of a derivative by inspecting a graph Algebraically calculate the value of a derivative Determine the derivative of a function using the limit of the difference quotient Determine an expression for the difference quotient of a given function Develop a foundational understanding of derivative notation and introductory facts	What is Calculus? Flip Chart DIfference Quotient Flip Chart Definition of Derivative Flip Chart Basic Power Rule Flip Chart Class Discussions Homework sets	Definition of Derivative Quiz
Derivative Rules	What shortcuts exist for determining the derivative of a function? How can I determine which derivative rule applies to a function? What is the process for applying each of the derivative rules?	Power Rule Product Rule Chain Rule Quotient Rule Trig derivatives Exponential and natural logarithm derivatives	Identify functions that have a structure which enables the application of the power/product/chain/quotient rule. Identify the derivative of trigonometric, logarithmic, and exponential function	Power Rule WeBWork Product Rule WeBWork Chain Rule WeBWork Class Discussions Homework sets	Power Rule Quiz Power Rule WeBWork Product Rule Quiz Product Rule WeBWork Chain Rule Quiz Chain Rule WeBWork

Unit	Essential Questions	Content	Skills	Activities	Assessment / Evidence of Learning
Derivative Rules (continued)			Apply the appropriate shortcut to determine the derivative of a function Algebraically identify and determine equivalent forms of a derivative		
Implicit & Higher Order Differentiation	What is meant by higher order differentiation? What notation is involved in higher order differentiation? In what situations is implicit differentiation useful? What is the process required to implicitly differentiate a function? How does implicit differentiation connect to previously learned lessons?	Implicit Differentiation Higher Order Differentiation Notation for higher order derivatives Higher Order Implicit Differentiation	Determine a higher order derivative for a given function Identify problems for which implicit differentiation would be a useful technique Apply to the process of implicit differentiation to determine a derivative Apply the concepts of higher order differentiation to solve problems	Higher Order Differentiation Flip Chart Implicit Differentiation 1 Flip Chart Implicit Differentiation 2 Flip Chart Higher Order & Implicit Differentiation WeBWork Class Discussions Homework sets	Higher Order & Implicit Differentiation WeBWork Higher Order & Implicit Differentiation Quiz

Unit	Essential Questions	Content	Skills	Activities	Assessment / Evidence of Learning
Related Rates	What formulas or equations can be used to model a given scenario? What is meant by the term “related rates”? How can we use derivatives to solve related rates problems?	Related Rates circle problems Related Rates square problems Related Rates triangle problems Related Rates cube problems Related Rates sphere problems Related Rates cone problems	Model a given circumstance algebraically Use algebraic skills to produce an equation in only one variable Identify and apply appropriate differentiation techniques based on the structure of an equation Solve an equation for a unknown value	Related Rates Intro Flip Chart Related Rates Circles & Squares Flip Chart Related Rates Spheres & Cubes Flip Chart Related Rates Triangles Flip Chart Related Rates Cones Flip Chart Related Rates WeBWorks A and B Class discussions Homework sets	Related Rates WebWork A Related Rates Quiz A Related Rates WeBWork B Related Rates Quiz B
Logarithmic Differentiation	How do you obtain the derivative of a term with a variable exponent? How can I use algebraic manipulation to simplify the process of logarithmic differentiation?	Logarithmic differentiation technique Properties of logarithms	Expand logarithmic expressions Condense logarithmic expression Convert between logarithmic and exponential form Apply the technique of logarithmic differentiation	Properties of Logarithms Flip Chart Logarithmic Differentiation Flip Chart Basic Logarithms WeBWork Class Discussions Homework sets	Basic Logarithm WeBWork Basic Logarithms Quiz Logarithmic Differentiation Quiz

Unit	Essential Questions	Content	Skills	Activities	Assessment / Evidence of Learning
Optimization	What does it mean to obtain an optimal value? How can I use calculus techniques to determine optimal values? What equation can I use to model a given circumstance?	Optimization procedure	Develop an expression to model a described circumstance Identify the correct differentiation technique for the expression Solve an equation for its zeroes	Optimization Flip Charts Optimization WeBWork A Optimization WeBWork B Class discussions Homework sets	Optimization Quiz A Optimization WeBWork A Optimization Quiz B Optimization WeBWork B
Curve Sketching	How can derivatives be used to sketch a curve? What is a critical value? How is it found? What are relative extrema and how are they found? What are inflection points and how are they found? What is concavity? How does it relate to derivatives?	Critical Values Absolute Maxima/Minima Relative Maxima/Minima Inflection Points Curve Sketching Curve Sketching on a restricted domain Concavity	Obtain critical values of a function Classify critical values and relative/absolute maxima or minima Identify inflection points Analyze the function to determine increasing and decreasing intervals both algebraically and graphically Interpret algebraic analysis of a function and produce a sketch of the curve	Curve Sketching Intro Flip Chart Max/ Min Flip Chart Increasing and Decreasing Intervals Flip Chart Inflection and Concavity Flip Chart Sketching Flip Chart Sketching on Closed Interval Flip Chart Increasing and Decreasing Intervals Activity Curve Sketching Activity	Curve Sketching Activity Curve Sketching WeBWork Curve Sketching Quiz

Unit	Essential Questions	Content	Skills	Activities	Assessment / Evidence of Learning
Curve Sketching (continued)				Curve Sketching WeBWork Class discussions Homework sets	
Integration	What is integration? What common applications does integration have? What is indefinite integration? What is definite integration?	Indefinite Integration Definite Integration Mean Value Theorem Area Under a Curve U -Substitution	Integrate polynomials, trigonometric, exponential, and logarithmic functions Calculate the average value attained by a function over a given interval Apply the techniques of definite integration to calculate the area under a curve Apply the process of U-Substitution	Introduction to Integration Flip Chart Indefinite Integration Flip Chart Definite Integration Flip Chart U-Substitution Flip Chart Basic Integration WeBWork U-Substitution WeBWork	Indefinite Integration Quiz Definite Integration & MVT Quiz Integration WeBWork Basic Integration WeBWork U Substitution WeBWork Indefinite Integration Quiz U -Substitution Quiz

Portrait of an Abington Heights Mathematician

By the end of Calculus, students will:

Limits and Continuity	**Derivatives**	**Applications of Derivatives**	**Analyzing Functions**	**Integrals**
☐ Estimate limits from graphs and tables ☐ Evaluate limits by algebraic manipulation ☐ Analyze graphs to determine one-sided limits	☐ Determine the derivative of a function using the limit of the difference quotient ☐ Find derivatives of functions using the product, quotient, power, and/or chain rules ☐ Evaluate the derivatives of trigonometric, exponential, and logarithmic functions ☐ Determine a higher order derivative for a given function ☐ Apply the process of implicit differentiation	☐ Use derivatives to solve related rates problems ☐ Use calculus-methods to determine optimal values ☐ Solve real-life optimization problems	☐ Use derivatives to sketch a curve by obtaining critical values of a function, classifying as relative or absolute minima/maxima, identifying inflection points, and analyzing function to determine increasing and decreasing intervals	☐ Integrate polynomials, trigonometric, exponential, and logarithmic functions ☐ Investigate properties of indefinite and definite integration ☐ Integrate with U-substitution