Greenwich Public Schools Curriculum Overview

Calculus

Personalized learning is achieved through standards-based, rigorous and relevant curriculum that is aligned to digital tools and resources.

Note: Teachers retain professional discretion in how the learning is presented based on the needs and interests of their students.

Course Description

Calculus - Full Year
024200 6 Blocks 1 Credit
Prerequisite: Honors Precalculus; or Precalculus 1 & 2 with a C or better.
This course is an introduction to the fundamentals of differential and integral calculus and their applications. Topics include: functions, limits, continuity, differentiation, integration and applications of these topics.

Unit Guide

Chapter R/1: Algebraic References & Linear Functions
Chapter 2: Nonlinear Functions
Chapter 3: The Derivative
Chapter 4: Calculating the Derivative
Chapter 5: Graphs and Derivatives
Midterm Review & Midterm Exam*
Chapter 6: Applications of the Derivative
Chapter 7: Integration
Chapter 8: Further Techniques and Applications of Integration
Final Review & Final Exam*

***Note**: Semester exam review packets, answer keys and formula sheets can be found by joining our **Schoology** *Math Department Review Course*, using COURSE access code P9V9X-H6V37.

Common Core Mathematical Practices

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.

AP CALCULUS Mathematical Practices (page 14 of hyperlinked document):

- *Implementing Mathematical Processes:* Determine expressions and values using mathematical procedures and rules
- *Connecting Representations:* Translate mathematical information from a single representation or across multiple representations.
- *Justification:* Justify reasoning and solutions.
- *Communication and Notation:* Use correct notation, language, and mathematical conventions to communicate results or solutions.

Enduring Understandings

- *Chapter R/1*:
  - Functions help to model, analyze and predict situations.
  - To obtain a solution to an equation, no matter how complex, always involves the process of undoing the operations.
  - Linear functions are characterized by a constant average rate of change (or constant additive change).
- *Chapter 2*:
  - Many real-world situations can be modeled with quadratic functions.
  - The degree of a polynomial and its leading coefficient will determine the shape of its graph, the maximum number of turning points, its end behavior, and the number of roots.
  - All zeros of a polynomial function can be found by using division to break the function down into the product of linear and quadratic factors.
  - The properties of logarithms can be used to change the form of equations to reveal solution paths.
  - The knowledge of exponents and logarithms can be used to solve exponential modeling problems where a piece of information is missing.
  - All data is not linear and many situations in economics, finance and science are represented with exponential and logarithmic curves.
- *Chapter 3*:
  - Calculus allows us to generalize knowledge about motion to diverse problems involving change.
  - Reasoning with definitions, theorems, and properties can be used to justify claims about limits.
  - Derivatives allow us to determine rates of change at an instant by applying limits to knowledge about rates of change over intervals.
- *Chapter 4*:
  - Recognizing that a function's derivative may also be a function allows us to develop knowledge about the related behaviors of both.
  - Recognizing opportunities to apply derivative rules can simplify differentiation.
- *Chapter 5*:
  - Derivatives allow us to determine rates of change at an instant by applying limits to knowledge about rates of change over intervals.
  - Recognizing opportunities to apply derivative rules can simplify differentiation.
  - A function's derivative can be used to understand some behaviors of the function.
- *Chapter 6*:
  - Derivatives allow us to solve real-world problems involving rates of change.
- *Chapter 7*:

    - Definite integrals allow us to solve problems involving the accumulation of change over an interval.
    - The Fundamental Theorem of Calculus connects differentiation and integration.
    - Recognizing opportunities to apply knowledge of geometry and mathematical rules can simplify integration.
- *Chapter 8*:
    - Recognizing opportunities to apply knowledge of geometry and mathematical rules can simplify integration.
    - Definite integrals allow us to solve problems involving the accumulation of change over an interval.

Essential Questions

- *Chapter R/1*:
    - How can we use linear equations and linear inequalities to solve real world problems?
    - How may linear functions model real world situations?
    - How may linear functions help us analyze real world situations and solve practical problems?
    - What happens to a parent function when you transform its graph?
    - What are the essential properties of the functions listed in the library of functions?
    - How can tables, graphs and rules relating variables be used to answer real-world and mathematical questions about the relationships between variables?
    - What makes a function even or odd?
    - What determines continuity and how can you find and describe discontinuities?
- *Chapter 2*:
    - How are quadratic equations used in the real world?
    - What are the different ways to solve quadratic equations and when is each appropriate?
    - What features distinguish the graph of a quadratic function from other graphs?
    - How can an understanding of polynomials help in understanding quadratic functions and equations?
    - What are the advantages and disadvantages of different forms of the quadratic function and different methods for solving quadratic equations?
    - How can you find all of the zeros of a polynomial function?
    - How can you write a polynomial function given its zeros?
    - How can you graph a polynomial function?
    - How can a polynomial function model real world applications and assist in drawing conclusions?
    - How are exponential functions and logarithmic functions related?
    - How do you use the properties of logarithms to rewrite expressions?
    - How do you solve exponential and logarithmic equations?
    - What real-world phenomena are modeled by exponential or logarithmic functions?
    - How is continuously compounded interest different from compound interest?
- *Chapter 3*:
    - Can change occur at an instant?
    - How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?
    - How do we close loopholes so that a conclusion about a function is always true?
    - How can a state determine the rate of change in high school graduates at a particular level of public investment in education (in graduates per dollar) based on a model for the number of graduates as a function of the state's education budget?

    - If you knew that the rate of change in high school graduates at a particular level of public investment in education (in graduates per dollar) was a positive number, what might that tell you about the number of graduates at that level of investment?

- *Chapter 4*:
    - How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?
    - Why do mathematical properties and rules for simplifying and evaluating limits apply to differentiation?
- *Chapter 5*:
    - If pressure experienced by a diver is a function of depth and depth is a function of time, how might we find the rate of change in pressure with respect to time?
- *Chapter 6*:
    - How are problems about position, velocity, and acceleration of a particle in motion over time structurally similar to problems about the volume of a rising balloon over an interval of heights, the population of London over the 14th century, or the metabolism of a dose of medicine over time?
    - Since certain indeterminate forms seem to actually approach a limit, how can we determine that limit, provided it exists?
- *Chapter 7*:
    - If compounding more often increases the amount in an account with a given rate of return and term, why doesn't compounding continuously result in an infinite account balance, all other things being equal?
    - How is integrating to find areas related to differentiating to find slopes?
- *Chapter 8*:
    - How is finding the number of visitors to a museum over an interval of time based on information about the rate of entry similar to finding the area of a region between a curve and the x-axis?
    - If compounding more often increases the amount in an account with a given rate of return and term, why doesn't compounding continuously result in an infinite account balance, all other things being equal?
    - Given information about a rate of population growth over time, how can we determine how much the population changed over a given interval of time?

Resources and Assured Experiences

Textbook Information:
Calculus with Applications
Pearson (2016~11th edition)
ISBN 978-0-321-979421

GHS Capstone Task:
Vision of the Graduate #3 - Explore, define, and solve complex problems
- The Physics of Flight - to complete after Chapter 6: Applications of the Derivative

Quarterly Grading - Quarter Grades will be determined using the following components:
- Participation (includes Classwork) = 10%
- Preparation (includes Homework) = 10%
- Assessments (both Summative & Formative) = 80%

Connecticut Common Core State Standards

- *Chapter R/1*: CCSS.MATH.CONTENT.HSA.APR.A.1, D.7; HSF.LE.B.5; 8.F.A.3.
- *Chapter 2*: CCSS.MATH.CONTENT.HSF.IF.C.7, C.7a, C.7c; HSF.BF.B.3; .HSA.REI.B.4, B.4a.
- *Chapter 4:* CCSS.MATH.CONTENT.HSF.IF.A.2
- *Chapter 5:* CCSS.MATH.CONTENT.HSF.IF.B.4; HSA.REI.B.3.

AP CALCULUS Mathematical Practices (page 14 of hyperlinked document)

- *Chapter 3*: 1.E, 2.B, 2.D, 3.B, 3C, 3.D, 3.E.
- *Chapter 4*: 1.C, 1.D, 1.E, 2.C, 3.C, 4.C.
- *Chapter 5*: 1.C, 1.E, 2.D, 2.E, 3.D, 3.E, 3.G.
- *Chapter 6*: 1.D, 1.E, 2.A, 3.D, 3.F.
- *Chapter 7*: 1.D, 1.E, 1.F, 2.C, 2.D, 3.D, 4.B, 4.C.
- *Chapter 8*: 1.D, 1.E, 2.B, 2.D, 3.D, 4.C.