Unit 3: Applications of Derivatives
AP/ECE Calculus
7 Class Meetings

Revised December 2019

Essential Questions
● How can the function and its first and second derivative be applied to real-world situations?

Enduring Understandings with Unit Goals
EU 1: Every function has extrema and critical points   • Identify local and absolute extrema, and classify critical points   **EU 2:** The Mean Value Theorem can be used to answer many questions about a function   • Determine if the MVT can be applied.   • Find a value at which the MVT is true.   **EU 3:** The graphs of f, f ', and f " are related in many ways   • Use the graph of f to find f ' and f "   **EU 4:** Derivatives and Antiderivatives are used in optimizing situations in mathematics, business, and economics   • Maximize profit and minimize cost   • Optimize area, volume, and perimeter

Standards
AP Calculus Curricular Requirements – College Board   • **CR1a** The course is structured around the enduring understandings within Big Idea 2: Derivatives.   • **CR2a** The course provides opportunities for students to reason with definitions and theorems.   • **CR2b** The course provides opportunities for students to connect concepts and processes.   • **CR2c** The course provides opportunities for students to implement algebraic/computational processes.   • **CR2d** The course provides opportunities for students to engage with graphical, numerical, analytical, and verbal representations and demonstrate connections among them.   • **CR2e** The course provides opportunities for students to build notational fluency.   • **CR2f** The course provides opportunities for students to communicate mathematical ideas in words, both orally and in writing.   • **CR3a** Students have access to graphing calculators.   • **CR3b** Students have opportunities to use calculators to solve problems.

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- **CR3c** Students have opportunities to use a graphing calculator to explore and interpret calculus concepts.
- **CR4** Students and teachers have access to a college-level calculus textbook.

MSMHS Academic, Civic, and Social Competencies

Competency 1. Read and write effectively for a variety of purposes.
Competency 2. Speak effectively with a variety of audiences in an accountable manner.
Competency 3: Make decisions and solve problems independently and collaboratively.
Competency 5. Contribute to a positive learning environment with respect and responsibility.

Unit Content Overview

1. Extreme Values of Functions
- Apply the Extreme Value Theorem
- Identify local and absolute extrema
- Identify critical points

2. Mean Value Theorem
- Apply the Mean Value Theorem to derivatives
- Explain why functions with the same derivative can vary by a constant
- Find an antiderivative of a function

3. Graphs of f, f ', and f "
- Use the first derivative test to determine extrema
- Determine concavity of a function using the second derivative
- Identify points of inflection

4. Antiderivatives
- Identify all possible functions from a derivative

5. Modeling and Optimization
- Optimize areas, profits, volumes, and costs

Interdisciplinary Connections
- Language Arts – Word problems
- Marine Science – Word problems

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Daily Learning Objectives with *TWPS Activities*
Students will be able to… • Use the Extreme Value Theorem to locate and classify extrema and critical points • Find values of the function that satisfy the Mean Value Theorem or state why it doesn't apply • Identify intervals in which the function is increasing or decreasing • Determine concavity and points of inflection of a function • Identify all possible functions from a derivative • Use calculus to find the optimum value of a function in real world situations

Instructional Strategies/Differentiated Instruction
• **HLP:** Academically Productive Talk • **HLP:** Writing to Learn (TWPS) • **HLP:** Effective Feedback • Lecture with notes • Guided notes • Accountable Talk • Student-led instruction • Independent problem-solving • Collaborative problem-solving • Cross-curricular problem solving (independent and collaborative) • Homework

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Assessments

FORMATIVE ASSESSMENTS:
    • White board examples
    • Mid-class check-ins
    • Exit Slips
    • Homework
    • Accountable Talk Discussions
    • Daily Think-Write-Pair Share (TWPS)
    • AP/ECE Exam Prep questions
    • Derivative Application Performance Task
        ○ MSMHS Rubric 3: Problem Solving
 	
SUMMATIVE ASSESSMENTS:
    ● Quiz on EU 1, 2 and 3
    ● Unit Test
    ● Derivative Application Performance Task

Unit Task
Unit Task Name: Derivative Applications Performance Task **Description:** Students will use information learned in this unit about how every function has extrema and critical points (EU 1), how to answer questions using the Mean Value Theorem (EU 2) how the graphs of f, f' and f'' are connected (EU 3) and how to use derivatives to optimize situations (EU 4) in order to answer AP free response questions to prepare for the AP exam. Students will be expected to use their knowledge learned in the unit to define key terms and demonstrate their understanding of the mathematical content. They will be required to justify their answers in alignment with AP expectations. **Evaluation**: MSMHS Rubric 3: Problem Solving

Unit Resources

● Finney, Ross L., Demana, Franklin D., Waits, Bert K., Kennedy, Daniel. *Calculus: Graphical, Numerical, Algebraic.* Fourth ed., Prentice Hall, 2012.
    ● Stewart, James. *Single Variable Calculus: Early Transcendentals.* Cengage Learning, 2016.
    ● MSMHS School-wide Rubrics
    ● Internet databases
    ● Laptops
    ● Graphing Calculators