

Unit 5: Applications of the Definite Integral

AP/ECE Calculus

3 Class Meetings (including midterm day)

Revised June 2019

Essential Questions

- How can we use algebra to manipulate integrals?
- Which method for determining the volume of revolution around a line is most appropriate?

Enduring Understandings with Unit Goals

- EU 1:** There are algebraic methods to evaluate integrals that do not have a specific rule.
- Implement “u” substitution to evaluate integrals
- EU 2:** The area between two curves can be found by subtracting their integrals.
- Evaluate the area between two curves
- EU 3:** When curves are revolved around an axis, they create 3 dimensional figures.
- Find the volume of revolution around the x and y-axis
 - Find the volume of revolution around a different horizontal or vertical line
 - Find the volume using cross-sections

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.
- **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.

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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. Antidifferentiation by Substitution

- Use “u” substitution to antidifferentiate a function

2. Areas in the plane

- Find the area enclosed by the intersection of two curves
- Find areas by integrating with respect to y

3. Volumes

- Find volumes of cross sections
- Determine volumes of solids generated by revolving around the x and y-axis
- Determine volumes of solids generated by revolving around other horizontal and vertical lines
- Employ integration methods for volume using the disc and washer method.

Interdisciplinary Connections

- Physics – Particle motion problems
- Language Arts – Word problems

Daily Learning Objectives with *TWPS Activities*

Students will be able to...

- Integrate using “u” substitution
- Find the area between two curves
- Evaluate different areas using different limits of integration
- Determine the volume of a solid using different cross-sections
- Determine the volume of a solid by revolving it around the x or y-axis
- Find the volume of a solid by revolving it around another horizontal or vertical line

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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

Assessments

FORMATIVE ASSESSMENTS:

- White board examples
- Mid-class check-ins
- Exit Slips
- Homework
- Accountable Talk Discussions
- Daily Think-Write-Pair Share (TWPS)
- AP Exam Prep questions – collected and graded
- MSMHS Rubric 5: Civic and Social Responsibility
- Rain Water Performance Task
 - MSMHS Rubric 3: Problem Solving

SUMMATIVE ASSESSMENTS:

- Unit Test
- Rain Water Performance Task

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Unit Task

Unit Task Name: Rain Water AP FRQ

Description: Students will use information learned in this unit about how to use algebraic techniques to evaluate integrals (EU 1) how to find the area between two curves (EU 2) and how a three dimensional figure is created when revolving a curve around an axis (EU 3) 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