Calculus Unit 6 Applications of Definite Integrals	25 to 30 days Established 14-15 Revised 20-21 Revised Nov 2021 Revised August 2023

Standard – NJSLS: F.LE, G.GPE, G.GMD, and S.ID
Applications of Definite Integrals (Chapter 7)

Strand:
F-LE: Linear, Quadratic, and Exponential Models
Construct and compare linear, quadratic, and exponential models and solve problems.
1b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
1c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit intervals relative to another.
G.GPE: Expression Geometric Properties with Equations
Translate between the geometric description and the equation for a conic section.
3. Derive the equation of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distance from the foci is constant.
G.GMD: Geometric Measurement and Dimension
Explain volume formulas and use them to solve problems
1. **Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.**
2. **Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.**
3. **Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.**
4. **Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.**

S-ID: Interpreting Categorical and Quantitative Data
Summarize, represent, and interpret data on a single count or measurement variable.
5. **Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. [**

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Curriculum aligned with: 2009 New Jersey Core Curriculum Content Standards for 21st Century Skills (9.1 A-F)

21st Century Theme: *Global Awareness ☐, Financial, economic, business and entrepreneurial literacy ☐, Civic literacy ☐, Health literacy ☐Environmental Literacy ☐*

21st Century Skills: *Critical Thinking & Problem Solving☐, Creativity and Innovation ☐, Collaboration, Teamwork and Leadership ☐, Cross-Cultural Understanding and Interpersonal Communications ☐, Communication and Media Fluency ☐, Accountability, Productivity and Ethics ☐*

Interdisciplinary Connection: Math=MA, English=ELA, Science=SCI, Social Studies=SS, Physical Education=PE, Art=ART, Music=MU, Technology=TECH, World Language=WL, Business = BU

Essential Questions	Enduring Understandings	Activities, Investigation, and Student Experiences
1. How can integrals be used to find areas of complex figures? 2. What are the practical applications of finding areas of complex figures? 3. What are the practical applications of finding volumes of complex figures? 4. How is calculus useful in science, business, and other fields?	*Students will understand:* ● The integral is a tool that can be used to calculate net change and total accumulation. ● Finding the area between curves, finding the area enclosed by intersecting curves, finding area using sub regions, integrating with respect to y, and using geometric formulas are all techniques that allow us to compute areas of complex regions of the plane. ● Using volume as an integral, square cross sections, and cylindrical shells all us to	***Task 1:** **Interdisciplinary SS** The rate of consumption of oil in the United States during the 1980s (in billions of barrels per year) is modeled by the function $c = 27.08 \cdot e^{t/25}$, where t is the number of years after January 1, 1980. Find the total consumption of oil in the United States from January 1, 1980 to January 1, 1990. **Answer**: ≈332.965 billion barrels **Task 2:** Find the area of the region enclosed by the line $y = 2$ and curve $y = x^2 - 2$.

	compute volumes of certain solids in three dimensions. ● The length of a smooth curve can be found using a definite integral. ● It is important to see applications of integrals as various accumulation functions.	**Answer:** 10 2/3 **Task 3:** Find the volume of the solid generated by revolving the region bounded by $y = \sqrt{x}$ and the lines y = 2 and x = 0 about a) The x- axis b) The y-axis c) The line y = 2 d) The line x = 4 **Answer:** a) 8π b) 32π/5 c) 8π/3 d) 224π/15
Content Statements	**Cumulative Progress Indicators**	**Modifications and/or Accommodations:** ● **Special Education:** Utilize a multi-sensory (VAKT) approach during instruction, provide alternate presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks. ● **English Language Learners:** Extend time requirements, preferred seating,

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Students will know… ● How to interpret a velocity function. ● How to find position from displacement. ● How to calculate total distance traveled. ● How to model the effects of acceleration. ● How to find net change from data**.** ● How to find the area between curves. ● How to find the area of an enclosed region. ● How to find area using sub regions. ● How to integrate with respect to y. ● How to use square cross-sections, circular cross-sections, and washer cross-sections to calculate volume. ● How to find volume using cylindrical shells. ● How to find the length of sine waves. ● How to find the work done by force.	● Tests ● Quizzes ● Practice problems for homework ● Workbook pages ● Worksheets	positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of online bilingual dictionary, and modified assessment and/or rubric. ● **Students at Risk of School Failure:** Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat instructions as needed. ● **Gifted Students:** Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related talent development opportunities **Spot Light On:** *Use multiple ways of assessing student understanding.* **Teacher Resources** online achievethecore resource online learnzillion resource online khanacademy resource online desmos resource online ixl resource

- How to calculate normal probabilities.

Desired Results

- **Integral as net change**
- **Areas in the plane**
- **Volumes**
- **Length of curves**
- **Applications from science and statistics**

Standards for Mathematical Practices

1. **Look for and make use of structure.**
2. **Look for and express regularity in repeated reasoning.**
3. **Make sense of problems and persevere in solving them.**
4. **Reason abstractly and quantitatively.**
5. **Construct viable arguments and critique the reasoning of others**
6. **Model with mathematics**
7. **Use appropriate tools strategically.**
8. **Attend to precision.**

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LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*

Leonardo Da Vinci - Famous artist. Believed to be dyslexic as handwriting was often in reverse

The mission is to ensure that every student is able to see themselves in our rich and diverse history.

Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***
Self-Awareness Social Awareness Self-Management Relationship Skills Responsible Decision-Making	• Recognizing the importance of self-confidence in handling daily tasks and challenges. • Demonstrate an awareness of the expectations for social interactions in a variety of ways. • Demonstrate an understanding of the need for mutual respect when viewpoints differ. • Recognize the skills needed to establish and achieve personal and educational goals. • Utilize positive communication and social skills to interact effectively with others. • Develop, implement, and model effective problem solving and critical thinking skills.

New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)									
	Amistad Law: *N.J.S.A. 18A 52:16A-88*		Holocaust Law: *N.J.S.A. 18A:35-28*	x	LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*	x	Diversity & Inclusion: *N.J.S.A. 18A:35-4.36a*		Standards in Action: *Climate Change*