Quarter 4 — Calculus

Quarter 1		Quarter 2		Quarter 3		Quarter 4
Preparation for Calculus, Limits and Their Properties, Differentiation		Differentiation (continued from Quarter 1), Logarithmic, Exponential, and Other Transcendental Functions		Applications of Differentiation, Integration		Logarithmic, Exponential, and Other Transcendental Functions, Differential Equations, Applications of Integration
August 12, 2019 – October 11, 2019		October 21, 2019 – December 20, 2019		January 6, 2020 – March 13, 2020		March 23, 2020 – May 22, 2020
C.F.LF.A.1	C.D.CD.B.6	C.D.AD.A.2	C.D.CD.B.6	C.D.AD.B.7	C.I.UI.B.7	C.I.UI.A.1
C.F.LF.A.2	C.D.CD.B.7	C.D.AD.A.4	C.D.CD.B.8	C.D.AD.B.8	C.I.AI.A.1	C.I.UI.A.2
C.F.LF.A.3	C.D.AD. A.1	C.D.AD.A.5	C.D.CD.B.9	C.D.AD.B.9	C.I.AI.A.2	C.I.UI.A.3
C.F.BF.A.1	C.D.AD. A.2	C.D.AD.A.6		C.D.AD.B.10	C.I.AI.A.3	C.I.UI.B.5
C.F.BF.A.2	C.D.AD. A.3	C.D.AD.B.7		C.D.AD.B.11		C.I.UI.B.6
C.F.C.A.1		C.D.AD.B.8		C.D.AD.B.12		C.I.UI.B.7
C.F.C.A.2		C.D.AD.B.9		C.D.AD.C.16		C.I.AI.A.1
C.F.C.A.3		C.D.AD.B.10		C.D.AD.C.18		C.I.AI.A.2
C.F.C.A.4		C.D.AD.B.11		C.I.UI.A.1		C.I.AI.A.3
C.D.CD.A.1		C.D.AD.B.12		C.I.UI.A.2		C.I.AI.B.4
C.D.CD.A.2		C.D.AD.B.13		C.I.UI.A.3		C.I.AI.B.5
C.D.CD.A.3		C.D.AD.C.15		C.I.UI.B.4		C.I.AI.B.6
C.D.CD.A.4		C.D.AD.C.17		C.I.UI.B.5		
C.D.CD.B.5		C.D.CD.B.5		C.I.UI.B.6		

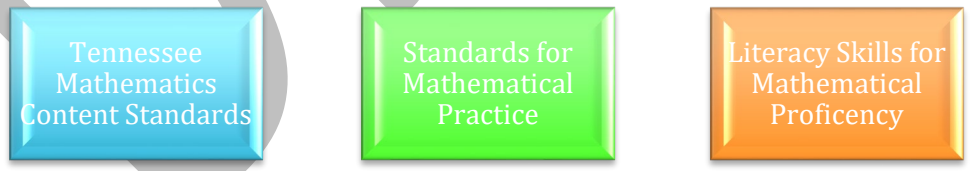
Introduction

Destination 2025, Shelby County Schools' 10-year strategic plan, is designed not only to improve the quality of public education, but also to create a more knowledgeable, productive workforce and ultimately benefit our entire community.

What will success look like?

In order to achieve these ambitious goals, we must collectively work to provide our students with high quality, college and career ready aligned instruction. The Tennessee State Standards provide a common set of expectations for what students will know and be able to do at the end of a grade. The State of Tennessee provides two sets of standards, which include the Standards for Mathematical Content and The Standards for Mathematical Practice. The Content Standards set high expectations for all students to ensure that Tennessee graduates are prepared to meet the rigorous demands of mathematical understanding for college and career. The eight Standards for Mathematical Practice describe the varieties of expertise, habits of mind, and productive dispositions that educators seek to develop in all students. The Tennessee State Standards also represent three fundamental shifts in mathematics instruction: **focus, coherence and rigor**.

Throughout this curriculum map, you will see resources as well as links to tasks that will support you in ensuring that students are able to reach the demands of the standards in your classroom. In addition to the resources embedded in the map, there are some high-leverage resources around the content standards and mathematical practice standards that teachers should consistently access. For a full description of each, click on the links below.



How to Use the Maps

Overview
An overview is provided for each quarter and includes the topics, focus standards, intended rigor of the standards and foundational skills needed for success of those standards.

Your curriculum map contains four columns that each highlight specific instructional components. Use the details below as a guide for information included in each column.

Tennessee State Standards
TN State Standards are located in the left column. Each content standard is identified as Major Content or Supporting Content (for Algebra I, Algebra II & Geometry only). A key can be found at the bottom of the map.

Content
This section contains learning objectives based upon the TN State Standards. Best practices tell us that clearly communicating measurable objectives lead to greater student understanding. Additionally, essential questions are provided to guide student exploration and inquiry.

Instructional Support & Resources
District and web-based resources have been provided in the Instructional Support & Resources columns. You will find a variety of instructional resources that align with the content standards. The additional resources provided should be used as needed for content support and scaffolding. The inclusion of vocabulary serves as a resource for teacher planning and for building a common language across K-12 mathematics. One of the goals for Tennessee State Standards is to create a common language, and the expectation is that teachers will embed this language throughout their daily lessons.

Topics Addressed in Quarter 4

- **Logarithmic, Exponential, and Other Transcendental Functions**
- **Differential Equations**
- **Applications of Integration**

Overview

Students have previously studied two types of elementary functions, algebraic functions and trigonometric functions. During quarter four, students study the properties, derivatives, and antiderivatives of logarithmic and exponential functions that have bases other than *e*. Students also study inverse trigonometric functions and find their derivatives and antiderivatives. Students study integration and a variety of applications associated with integration. They find the area of a region bounded by two curves, and find the volume of a solid of revolution by disk and shell methods. Students study Riemann Sums and definite integrals, the Fundamental Theorem of Calculus, and integration by substitution and by using the Trapezoidal Rule. Students investigate applications of differentiation and integration throughout the quarter.

TN State Standards	Content	Instructional Support & Resources	
Chapter 5: Logarithmic, Exponential, and Other Transcendental Functions **Chapter 6: Differential Equations** **(Allow approximately 4 - 5 weeks for instruction, review, and assessment)**			
Domain: Calculate and Apply Integrals **Cluster**: Apply techniques of differentiation **C.I.AI.A.1** Develop facility with finding antiderivatives that follow directly from derivatives of basic functions (power, exponential, logarithmic, and trigonometric).	**Enduring Understandings**: • Derivatives and anti-derivatives have an inverse relationship to each other. • The area under the curve is the geometric meaning of anti-derivatives. • The anti-derivative has both theoretical and real life applications. **Essential Questions:** • How are the rules for differentiation used to develop the basic rules of integration? • How can we use the measure of area under a curve to discuss net change of a function over time?	5.5: Bases Other than *e* and Applications 5.7: Inverse Trigonometric Functions: Integration **Additional Resource(s)** Larson Calculus Videos – Section 5.5 Visual Calculus Tutorials Video – Bases Other than e and Applications Video - Inverse Trigonometric Functions: Integration Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Chapter 5 Vocabulary (5-5 & 5-7)** Base, exponential function to the base *a*, logarithmic function to the base *a*, separation of variables

TN State Standards	Content	Instructional Support & Resources	
	• How are area under the curve and the definite integral related? **Objectives:** Students will: • Integrate exponentials that have bases other than *e*. • Use exponential functions to model compound interest and exponential growth. • Integrate functions whose antiderivatives involve inverse trigonometric functions.		
Domain: Calculate and Apply Integrals **Cluster**: Apply integrals to solve problems **C.I.AI.B.6** Use integrals to solve a variety of problems (e.g., distance traveled by a particle along a line, exponential growth/decay).	**Objectives:** Students will: • Use separation of variables to solve a simple differential equation. • Use exponential functions to model growth and decay in applied problems.	6.2: Differential Equations **Additional Resource(s)** Larson Calculus Videos – Section 6.2 Visual Calculus Tutorials Khan Academy (Differential equations) Differential Equations Video: Differential Equations: Growth & Decay Calculus Activities Using the TI-84	**Vocabulary** Exponential growth, exponential decay **Writing in Math/Discussion** Suppose an insect population increases by a constant number each month. Explain why the number of insects can be represented by a linear function. Suppose an insect population increases by a constant percentage each month. Explain why the number of insects can be represented by an exponential function.
Chapter 7: Applications of Integration **(Allow approximately 4-5 weeks for instruction, review, and assessment)**			
Domain: Calculate and Apply Integrals **Cluster**: Apply techniques of differentiation **C.I.AI.A.1** Develop facility with finding antiderivatives that follow directly from derivatives of basic	**Objectives:** Students will: • Find the area of a region between two curves using integration.	7.1: Area of a Region Between Two Curves **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 7.1	**Chapter 7 Vocabulary (7-1, 7-2, 7-3)** Representative rectangle, solid of revolution, axis of revolution, disk method, outer radius, inner radius, shell method

TN State Standards	Content	Instructional Support & Resources	
functions (power, exponential, logarithmic, and trigonometric). **Domain**: Calculate and Apply Integrals **Cluster**: Apply integrals to solve problems **C.I.AI.B.4** Use a definite integral to find the area of a region.	• Find the area of a region between intersecting curves using integration. • Describe integration as an accumulation process.	Calculus Tutorial Videos Khan Academy (Integrals) Calculus Activities Using the TI-84	**Writing in Math/ Discussion** Have students write how they use rectangles to find the approximate area between two curves.
Domain: Calculate and Apply Integrals **Cluster**: Apply integrals to solve problems **C.I.AI.B.5** Use a definite integral to find the volume of a solid formed by rotating around a given axis.	**Objectives:** Students will: • Find the volume of a solid of revolution using the disk method. • Find the volume of a solid of revolution using the washer method. • Find the volume of a solid with a known cross section. • Find the volume of a solid of revolution using the shell method. • Compare the uses of the disk method and the shell method.	7.2: Volume: The Disk Method 7.3: Volume: The Shell Method **Additional Resource(s)** Larson Calculus Videos – Section 7.2 Larson Calculus Videos – Section 7.3 Volume of a Solid Revolution Visual Calculus Tutorials Khan Academy Calculus Videos EngageNY Precalculus and Advanced Topics Module 3, Topic A, Lesson 9: Volume and Cavalieri's Principle Calculus Activities Using the TI-84	**Section Project (after 7.3)** *The Oblateness of Saturn* See engageny Lesson for Exit Ticket/Discussion Questions.
Domain: Understanding Integrals **Cluster**: Demonstrate understanding of a Definite Integral **C.I.UI.A.1** Define the definite integral as the limit of Riemann sums and as the net accumulation of change. **C.I.UI.A.2**	**Objectives:** Students will: • Understand the definition of Riemann sums. • Evaluate a definite integral using limits. • Evaluate a definite integral using properties of definite integrals.	4.3: Riemann Sums and Definite Integrals **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.3 Calculus Tutorial Videos Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Writing in Math/Discussion** Give an example of a function that is integrable on the interval [-1, 1], but not continuous on [-1, 1]

TN State Standards	Content	Instructional Support & Resources	
Correctly write a Riemann sum that represents the definition of a definite integral.			
Domain: Understanding Integrals **Cluster**: Understand and apply the Fundamental Theorem of Calculus **C.I.UI.B.5** Evaluate definite integrals using the Fundamental Theorem of Calculus. **C.I.UI.B.6** Use the Fundamental Theorem of Calculus to represent a particular antiderivative of a function and to understand when the antiderivative so represented is continuous and differentiable. **C.I.UI.B.7** Apply basic properties of definite integrals.	**Objectives:** Students will: • Evaluate a definite integral using the Fundamental Theorem of Calculus. • Understand and use the Mean Value Theorem for integrals. • Find the average value of a function over a closed interval. • Understand and use the Second Fundamental Theorem of Calculus.	4.4: The Fundamental Theorem of Calculus **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.4 Calculus Tutorial Videos Video: The Fundamental Theorem of Calculus Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Writing in Math/Discussion** Research and prepare a report on the Fundamental Theorem of Calculus and the mathematicians Isaac Newton and Gottfried Leibniz.
Domain: Calculate and Apply Integrals **Cluster**: Apply techniques of antidifferentiation **C.I.AI.A.1** Develop facility with finding antiderivatives that follow directly from derivatives of basic functions (power, exponential, logarithmic, and trigonometric). **C.I.AI.A.2** Use substitution of variables to calculate antiderivatives (including changing limits for definite integrals). **C.I.AI.A.3** Find specific antiderivatives using initial conditions.	**Objectives:** Students will: • Use pattern recognition to find an indefinite integral. • Use change of variables to find an indefinite integral. • Use the general power rule for integration to find an indefinite integral. • Use a change of variables to evaluate a definite integral. • Evaluate a definite integral involving an even or odd function.	4.5: Integration by Substitution **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.5 Calculus Tutorial Videos Video: Integration by Substitution Khan Academy Calculus Videos Calculus Activities Using the TI-84	

TN State Standards	Content	Instructional Support & Resources	
Domain: Understanding Integrals **Cluster**: Demonstrate understanding of a Definite Integral **C.I.UI.A.3** Use Riemann sums (left, right, and midpoint) and trapezoidal sums to approximate definite integrals of functions, represented graphically, numerically, and by tables of values.	**Objectives:** Students will: • Approximate a definite integral using the Trapezoidal Rule.	4.6: Numerical Integration **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.6 Calculus Tutorial Videos Video: Numerical Integration Khan Academy Calculus Videos Calculus Activities Using the TI-84	

RESOURCE TOOLKIT		
Textbook Resources Larson/Edwards *Calculus of a Single Variable* © 2010 Larson Calculus	**Standards** Common Core Standards - Mathematics Common Core Standards - Mathematics Appendix A Edutoolbox.org (formerly TN Core) The Mathematics Common Core Toolbox Tennessee Academic Standards for Mathematics	**Videos** Larson Calculus Videos Khan Academy Hippocampus Brightstorm Pre-Calculus Review
Calculator Calculus Activities Using the TI-84 Texas Instruments Education Casio Education TI Emulator Desmos	**Interactive Manipulatives** http://www.ct4me.net/math_manipulatives_2.htm Larson Interactive Examples	**ACT & SAT** TN ACT Information & Resources ACT College & Career Readiness Mathematics Standards SAT Connections SAT Practice from Khan Academy
Additional Sites Visual Calculus Tutorials Lamar University Tutorial PowerPoint Lectures Algebra Cheat Sheet Trigonometry Cheat Sheet Online Algebra and Trigonometry Tutorial Study Tips for Math Courses MathBits Calculus Resources Interactive Mathematics Lessons http://www.freemathhelp.com/calculus-help.html http://www.calculus.org/ http://www.calcchat.com/ http://functions.wolfram.com http://www.analyzemath.com/Graphing/piecewise_functions.html		