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 6 2018 – October 5, 2018		October 15, 2018 – December 19, 2018		January 7, 2019 – March 8, 2019		March 18, 2019 – May 23, 2019
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.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		

Tennessee Academic Standards for Mathematics

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?

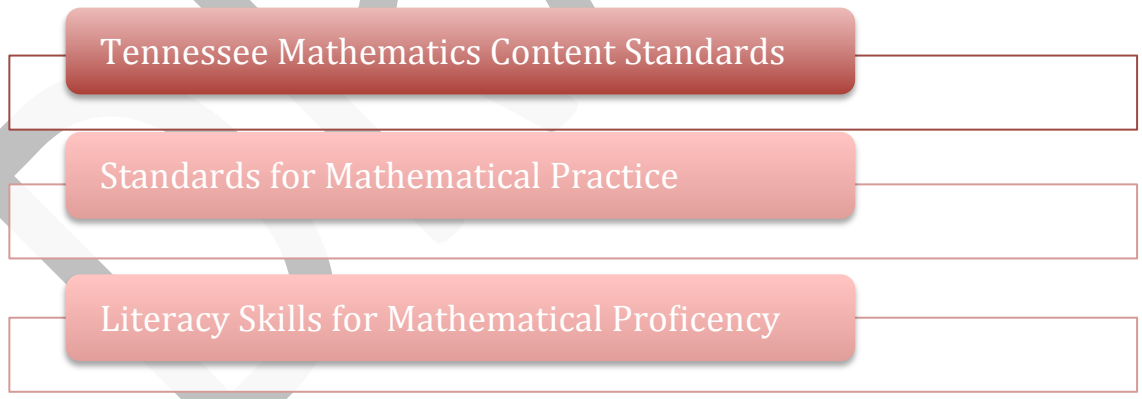
In order to achieve these ambitious goals, we must collectively work to provide our students with high quality, college and career ready aligned instruction. The Tennessee State Standards provide a common set of expectations for what students will know and be able to do at the end of a grade. The State 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**.

Tennessee Academic Standards for Mathematics

The **Standards for Mathematical Practice** describe varieties of expertise, habits of minds and productive dispositions that mathematics educators at all levels should seek to develop in their students. These practices rest on important National Council of Teachers of Mathematics (NCTM) "processes and proficiencies" with longstanding importance in mathematics education. Throughout the year, students should continue to develop proficiency with the eight Standards for Mathematical Practice. The following are the eight Standards for Mathematical Practice:

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

This curriculum map is designed to help teachers make effective decisions about what mathematical content to teach so that ultimately our students can reach Destination 2025. 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.



Tennessee Academic Standards for Mathematics

Structure of the Standards

Structure of the TN State Standards include:

- **Content Standards** - Statements of what a student should know, understand, and be able to do.
- **Clusters** - Groups of related standards. Cluster headings may be considered as the big idea(s) that the group of standards they represent are addressing. They are therefore useful as a quick summary of the progression of ideas that the standards in a domain are covering and can help teachers to determine the focus of the standards they are teaching.
- **Domains** - A large category of mathematics that the clusters and their respective content standards delineate and address. For example, Number and Operations – Fractions is a domain under which there are a number of clusters (the big ideas that will be addressed) along with their respective content standards, which give the specifics of what the student should know, understand, and be able to do when working with fractions.
- **Conceptual Categories** – The content standards, clusters, and domains in the 9th-12th grades are further organized under conceptual categories. These are very broad categories of mathematical thought and lend themselves to the organization of high school course work. For example, Algebra is a conceptual category in the high school standards under which are domains such as Seeing Structure in Expressions, Creating Equations, Arithmetic with Polynomials and Rational Expressions, etc.

Tennessee Academic Standards for Mathematics

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.

Tennessee Academic Standards for Mathematics

Topics Addressed in Quarter 3

- **Applications of Differentiation**
- **Integration**

Overview

During this quarter, students discover some of the many applications of the derivative. Students will continue to graph relationships between f, f′, and f″ and solve problems that involve rates of change and motion – functionalize, derivate, test for extrema, and solve. Students are taught how to approach a particular problem in calculus and use the calculator as a tool in the solution process. The unit on integration will supply the students with the capability of integrating a variety of function types. It is necessary for them to integrate by hand as well as with a calculator. The relationship between the Riemann Sums and the definite integral is a major point of interest and The Trapezoidal Rule helps to demonstrate the idea of the definite integral representing summation, once again.

TN State Standards	Content	Instructional Support & Resources	
Chapter 3: Applications of Differentiation **(Allow approximately 3 weeks for instruction, review, and assessment)**			
Domain: Computing and Applying Derivatives **Cluster**: Use first and second derivatives to analyze a function **C.D.AD.B.7** Relate the increasing and decreasing behavior of *f* to the sign of *f'* both analytically and graphically. **C.D.AD.B.8** Use the first derivative to find extrema (local and global). **C.D.AD.B.9**	**Essential Questions:** • What does the derivative tell us? • How can the derivative be used to solve optimization problems? • How do rates of change relate in real-life settings? **Objectives:** Students will: • Analyze the graphs of polynomials, rational, radical, piecewise, and transcendental functions using	3.6: A Summary of Curve Sketching **Additional Resource(s)** Larson Calculus Videos – Section 3.6 Visual Calculus Tutorials Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Chapter 3 Vocabulary (3-6, 3-7 & 3-9):** asymptotes, critical numbers, points of inflection, test intervals, primary equation, secondary equation, differential of *x*, differential of *y*, propagated error, differential form **Writing in Math/Discussion** Suppose $f'(t) < 0$ for all t in the interval (2, 8). Explain why $f(3) > f(5)$.

Tennessee Academic Standards for Mathematics

TN State Standards	Content	Instructional Support & Resources	
Analytically locate the intervals on which a function is increasing, decreasing, or neither. **C.D.AD.B.10** Relate the concavity of *f* to the sign of *f"* both analytically and graphically. **C.D.AD.B.11** Use the second derivative to find points of inflection as points where concavity changes. **C.D.AD.B.12** Analytically locate intervals on which a function is concave up or concave down.	appropriate technology. Discuss which functions behave "nicely" with respect to algebraic properties and which do not. Justify your discussions. • Describe asymptotic behavior (analytically and graphically) in terms of infinite limits and limits at infinity. • Given a complete set of algebraic information and calculus information, construct a sketch of a function that matches the given data. Display several functions that satisfy one set of data. Describe their differences and similarities. • Give a sketch of a graph of a function and completely describe the function in mathematical terms so that the sketch could be replicated from the description and would be close to the original graph.		
Domain: Computing and Applying Derivatives **Cluster**: Apply derivatives to solve problems **C.D.AD.C.16** Solve optimization problems to find a desired maximum or minimum value.	**Objectives:** Students will: • Use optimization to find extreme values (relative and absolute).	3.7: Optimization Problems **Additional Resource(s)** Larson Calculus Videos – Section 3.7 Visual Calculus Tutorials Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Writing in Math/Discussion** A shampoo bottle is a right circular cylinder. Because the surface area of the bottle does not change when it is squeezed, is it true that the volume remains the same? Explain.
Domain: Computing and Applying Derivatives **Cluster**: Apply derivatives to solve problems **C.D.AD.C.18** Use tangent lines to approximate function values and changes in function values when	**Objectives:** Students will: • Understand the concept of a tangent line approximation. • Compare the value of the differential, dy,	3.9: Differentials **Additional Resource(s)** Larson Calculus Videos – Section 3.9 Visual Calculus Tutorials	**Writing in Math/Discussion** Describe the change in accuracy of *dy* as an approximation for Δy when Δx is decreased. When using differentials, what is meant by the

TN State Standards	Content	Instructional Support & Resources	
inputs change (linearization).	with the actual change in y, Δy. • Estimate the propagated error using a differential. • Find the differential of a function using differentiation formulas.	Khan Academy Calculus Videos Calculus Activities Using the TI-84	terms *propagated error, relative error,* and *percent error*?
Chapter 4: Integration **(Allow approximately 6 weeks for instruction, review, and assessment)**			
Domain: Understanding Integrals **Cluster**: Understand and apply the Fundamental Theorem of Calculus **C.I.UI.B.4** Recognize differentiation and antidifferentiation as inverse operations.	**Essential Question(s)** • 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? • How is the anti-derivative related to the accumulation function? • How is the area under the curve and the definite integral related? • How are the properties of definite integrals related to the Riemann sum definition? • How can one apply numerical techniques to compute an integral without knowing the associated antiderivative? **Objectives:** Students will: • Write the general solution of a differential equation. • Use indefinite integral notation for antiderivatives. • Use basic integration rules to find antiderivatives. • Find a particular solution of a differential	4.1: Antiderivatives and Indefinite Integration **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.1 Calculus Tutorial Videos Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Chapter 4 Vocabulary:** Antiderivative, constant of integration, general derivative, general solution, differential equation, antidifferentiation (indefinite integration), indefinite integral, particular solution, initial condition, sigma notation, index of summation, upper and lower bounds of summation, inscribed rectangle, circumscribed rectangle, lower sum, upper sum, Riemann sum, integrable, definite integral, lower limit, upper limit, Fundamental Theorem of Calculus (I and II), net change, displacement, Integration by Substitution, Pattern Recognition, change of variables, integration of odd and even functions, Trapezoidal Rule, Simpson's Rule **Writing in Math/Discussion** What is the difference, if any, between finding the antiderivative of $f(x)$ and evaluating the integral $\int f(x)\,dx$?

TN State Standards	Content	Instructional Support & Resources	
	equation.		
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: • Use Sigma notation to write and evaluate a sum. • Approximate the area of a plane region using limits. • Find the area of a plane region using limits.	4.2: Area **Additional Resource(s)** Larson Calculus Videos – Section 4.2 Visual Calculus Tutorials Khan Academy Calculus Videos Calculus Activities Using the TI-84	**Writing in Math/Discussion** In your own words using appropriate figures, describe the methods of upper sums and lower sums in approximating the area of a region. Give the definition of the area of a region in the plane.
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** Correctly write a Riemann sum that represents the definition of a definite integral.	**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]
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	**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	4.4: The Fundamental Theorem of Calculus **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.4 Calculus Tutorial Videos Khan Academy Fundamental Theorem of Calculus Videos Calculus Activities Using the TI-84	**Writing in Math/Discussion** What is the Fundamental Theorem of Calculus, I and II?

TN State Standards	Content	Instructional Support & Resources	
antiderivative so represented is continuous and differentiable. **C.I.UI.B.7** Apply basic properties of definite integrals.	Fundamental Theorem of Calculus.		
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 Khan Academy Calculus Videos Calculus Activities Using the TI-84	
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. • Approximate a definite integral using Simpson's Rule. • Analyze the approximate errors in the Trapezoidal Rule and Simpson's Rule.	4.6: Numerical Integration **Additional Resource(s)** Visual Calculus Tutorials Larson Calculus Videos – Section 4.6 Calculus Tutorial Videos Khan Academy Calculus Videos Calculus Activities Using the TI-84	

RESOURCE TOOLBOX		
Textbook Resources Larson/Edwards *Calculus of a Single Variable* © 2010 Larson Calculus	**Standards** Common Core Standards - Mathematics Common Core Standards - Mathematics Appendix A The Mathematics Common Core Toolbox Tennessee Standards for Mathematics	**Videos** Larson Calculus Videos Khan Academy Hippocampus Brightstorm Pre-Calculus Review University of Houston Videos
Calculator Calculus Activities Using the TI-84 TICommonCore.com Texas Instruments Education Casio Education TI Emulator	**Interactive Manipulatives** http://www.ct4me.net/math_manipulatives_2.htm Larson Interactive Examples	
Additional Sites Visual Calculus Tutorials Lamar University TutorialPowerPoint Lectures Algebra Cheat Sheet Trigonometry Cheat Sheet Online Algebra and Trigonometry Tutorial Study Tips for Math Courses MathBits Calculus Resources 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 Edutoolbox.org (formerly TN Core)		