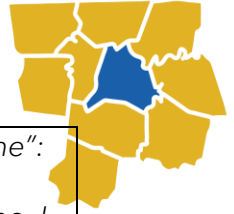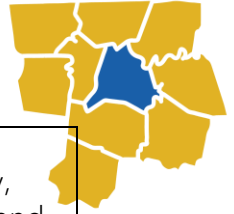# High School STEM Education Curriculum

CONTEXT	
Unit Name	Introduction to Multi-Modal Transportation Planning and Engineering
Grade Level	9th or 10th
Home-Base Course	STEM 1: Foundations
Total Duration	Recommended: 11 hours (does not include work site visits)
OVERVIEW	
Essential Questions	• How does transit and mobility affect communities, especially in Middle Tennessee? • What does it take to have a better multi-modal transportation system? What type of work goes into planning and engineering for better systems? • How can we, as students and future adults, support improving multi-modal transportation systems in our community?
Outcomes	• Students will develop an understanding of the need for a robust regional multi-modal transportation system. • Students will explore the transit landscape in Middle Tennessee and how it relates to regional growth, equity, and quality of life. • Students will be exposed to concepts in multi-modal transportation planning and engineering • Students will engage in collaborative, project-based learning experiences using the engineering design process to address an issue in their community with improved transit infrastructure. • Students will explore multi-modal transportation systems engineering as a potential career and will have the opportunity to meet professionals in the field.
ORGANIZATION	
Module 1 (2 hours) *Foundations of Multi-Modal Transportation Systems*	
Lesson Topics	1.1 Public Transportation and Communities: Past and Present 1.2 Opportunities and Challenges in Middle Tennessee
CTE STEM Foundation 1 Standards	• Analyze multiple aspects of a problem scenario to identify cause/effect patterns. Consider the history of a problem to identify factors such as risks and benefits. • Analyze solutions to a real-world problem collaboratively, to identify critical factors of the steps of the design process. Explain why these factors are critical. • Given a real-world STEM scenario, identify the problem and develop meaningful questions.
Module 2 (4 hours) *Engineering and Planning Concepts in Multi-Modal Transportation Systems*	

Lesson Topics	**2.1** *"Transit takes me when I want to go. It is a good use of my time"*: Modal Characteristics and Capacity **2.2** *"Transit takes me when I want to go. It is a good use of my time. I can trust it"*: Frequency and Reliability **2.3** *"Transit takes me where I want to go. It gives me flexibility."*: Land use, High Capacity Corridors, and Transit-Oriented Developments **2.4** *"It is a good use of my money"*: Funding, Supply, and Demand
CTE STEM Foundations 1 Standards	• Sort and evaluate data for its significance and/or meaning in the process of solving a problem as a STEM professional would. Examine the data in ways that reveal the relationships, patterns, and trends that can be found within it. • Identify multiple forms of data and list mechanisms for collection that are essential to solving a problem. • Use available data to create an original prototype/solution to a scenario. • Explore mathematical models and/or computer simulations that are used by scientists and engineers to accurately predict the effect of components of their original prototype design. Examine a range of resources (e.g. texts, experiments, simulations) to consider which models are likely to be most efficient, economic, and beneficial. Write a justification to support the conclusion. • Analyze data from scientific investigation or prototype testing and accurately identify the cause of the results. Examine constraints including cost, safety, reliability, and aesthetics. Consider social, cultural, and environmental impacts. Summarize findings using tables, functions, graphical representations, and written explanations.
Module 3 (4-5 hours) *Investigating a Transit-Related Community Issue: Project-Based Learning*
Students will:	**3.1** Identify an issue that can be addressed with improved public transit structures. Identify criteria and constraints. **3.2** Brainstorm possible solutions. Research and generate ideas and explore alternative solutions. **3.3/3.4/3.5** Select an approach and produce a deliverable to showcase idea(s) and solution(s).
CTE STEM Foundations 1 Standards	• Given a real-world problem, identify several possible solutions using both the engineering design process and scientific inquiry. • Analyze solutions to a real-world problem collaboratively, to identify critical factors of the steps of the design process. Explain why these factors are critical. • Given a real-world STEM scenario, identify the problem and develop meaningful questions. Differentiate between necessary and non-essential information as well as needs and wants for applying the scientific method of investigation or the engineering design process. • Collaborate to write a fictional, yet plausible, STEM problem-based scenario. Evaluate possible solutions, aligning work with

	the steps of the scientific method or the engineering design process. Consider possible constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
Job Exploration and Work Site Visits **(Time TBD)**	
Students will:	• Investigate the types of tasks that a multi-modal transportation engineer or planner performs. • Investigate the skills and education required for these careers.
Community Partner Opportunities	• WeGo Transit • Nashville-region Engineering Firms