Colorado CTE Course – Scope and Sequence

Course Name	Engineering 1	Course Details	1.0
		Course = 0.50 Carnegie Unit Credit	
Course Description	This course introduces basic engineering concepts and foundations. It provides an overview of skills necessary to be successful in all fields of engineering including spatial reasoning & design drafting, materials analysis, basic physics/dynamics, and basic manufacturing and production.		
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.		
SCED Identification #		Schedule calculation based on 60 calendar days of a 90-day semester. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.	

All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at **https://www.cde.state.co.us/standardsandinstruction/essentialskills**

Instructional Unit Topic	Suggested Length of Instruction	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Unit 1 **Technical Drawing/Drafting / CAD**	2-4 weeks	Read and understand technical drawings. Demonstrate understanding of annotation styles and setup by defining units, dimension styles, and leader lines Create drawings that incorporate external referencing Create and render objects using modeling tools Model individual parts or assemblies Interpret engineering drawings	Technical Drawing/ Drafting Drafting Tools Visual/Spatial Intelligence Orthographic Isometric Measurement Intro w/ TinkerCAD Digital Tools (platforms) for more advanced CAD • Solidworks • OnShape • FreeCAD Continued development of spatial reasoning Design with fittings/ moving parts. Develop Technical Skills: • Technical Sketching/Drawing • Computer Modeling (CAD)	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-1 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem MS-ETS1-2 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3	**CAD Foundations (TSA competition)** Participants have the opportunity to demonstrate their understanding of CAD fundamentals as they create a two-dimensional (2D) graphic representation of an engineering part or object. **Off the Grid (TSA competition)** Participants conduct research on a sustainable architectural design for a home in a country of the team's choosing (other than their

					home country), and document their findings in a display and a model. The model can be of the home designed by the team, or of a specific aspect of their design. Semifinalist teams give a presentation and are interviewed about their design.
Unit 2 **Civil/ Structural Analysis/ Architecture**	2-4 weeks	Use various input technologies to enter and manipulate information appropriately. Improve a system design to meet a specified need, including properties of materials selected. Describe engineering disciplines (e.g., civil) -a. Job roles -b. Professional societies -c. Applicable licenses and/or certifications Demonstrate an understanding of and discuss how teams function Apply teamwork to solve problems Prepare a project budget	Structural Engineering Live/Dead Load Forces on structures Evaluate: data collection and pro/con analysis Design Criteria SketchUp; form and function of living spaces Compare class structures; material selections with how it performs/ "buy" materials Statistical Analysis	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-1 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-ETS1-4	**Structural Engineering (TSA competition)** Participants apply the principles of structural design and engineering through basic research, design, construction, and destructive testing to determine the design efficiency of a structure. **Construction Challenge (TSA competition)** Participants submit a scale model/prototype with a portfolio that documents the use of their leadership and technical skills to fulfill an identified community need related to construction. Semifinalists discuss their projects in a presentation and

					an interview.
Unit 3 Aerospace / Fluid Dynamics	2-4 weeks	Identify and explain the intended use of safety equipment available in the classroom Develop a plan for production of an individual product Demonstrate critical thinking, identify the system constraints, and make fact-based decisions Use tools, laboratory equipment, and precision measuring instruments to develop prototypes Identify and describe the steps needed to produce a prototype Identify and use appropriate tools, equipment, machines, and materials to produce the prototype	Satellites Rocket design Principles of Flight Car Aerodynamics/design Boat Design	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-1 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem MS-ETS1-2 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-ETS1-4	**Dragster (TSA competition)** Participants design and produce a race-worthy CO2-powered dragster according to stated specifications, using only specified materials. **Flight (TSA competition)** Participants study the principles of flight and design in order to fabricate a glider that stays in flight for the greatest elapsed time. The glider must be designed to be launched from a catapult that is provided onsite. The design process is documented in a portfolio that is submitted for evaluation.
Unit 4 Robotics (design and build)	2-4 weeks	Describe current hardware Configure and install hardware Diagnose design/functionality	Historical Use and Applications of Robotics in STEM related careers Simple machines Gear ratios	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential	**VEX IQ Challenge (TSA competition)** Participants collaborate on a robotics project –

		problems and repair hardware Demonstrate an understanding of and discuss how teams function Apply teamwork to solve problems Use rational thinking to develop or improve a system Identify and use appropriate tools, equipment, machines, and materials to produce the prototype	Forces Focus is on Design and Build of a robot to solve a problem in a STEM field Block Programing	impacts on people and the natural environment that may limit possible solutions. MS-ETS1-1 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem MS-ETS1-2 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-ETS1-4	in which they build a robot that incorporates the relationship among STEM fields – culminating in a robot skills challenge that evaluates the robot's efficiency and productivity. **System Control Technology (TSA Competition)** In response to a challenge presented onsite at the conference, participants analyze a problem (typically one in an industrial setting), build and program a computer-controlled mechanical model to solve the problem, explain the program and the features of the mechanical model solution, and provide instructions for evaluators to operate the device.
Unit 5 Career & Education Opportunities	2-4 weeks		Identify various fields within engineering fields and their respective career opportunities. a. Recognize the work typically performed, tools and technology used, and		

			nature of work environment b. Identify potential certification opportunities c. Find membership organizations associated with the careers d. Understand the necessary education associated within the careers e. Research security clearance requirements associated within the careers		