

Colorado CTE Course – Scope and Sequence

Course Name	Introduction to Technical Drawing and Design		Course Details	Credit = 1.0	
			Course = 0.50 Carnegie Unit Credit		
Course Description	This yearlong course develops skills in drafting and design of structures and products. This is accomplished by introducing a design process of refining sketches through technical hand and computer-aided drafting. The use of a CAD-CAM program will allow students to visually apply creative design elements to specific projects.				
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 #	21102	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
Careers in Technical Design and Drafting		<p>Explore the professional standards and employability skills required by business and industry in a multitude of industries that employ drafters and designers.</p> <p>Understand the evolution of design drafting, including its technological progression and emerging trends.</p>	<p>The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:</p> <p>(A) describe how teams function; (B) explain employers' work expectations; and (C) demonstrate knowledge of the concepts and skills related to health and safety in the workplace as specified by</p>	<p>Evaluate jobs data and employment projections in the transportation industry from sources such as O*Net OnLine, synthesizing findings from each source.</p> <ul style="list-style-type: none"> Determine areas of largest growth within the drafting and design occupations as they relate to multiple industries. Report job requirements and characteristics for selected careers and compare personal interests and aptitudes with job requirements and characteristics of the career selected. Discuss industry certification opportunities and their requirements. 	<p>SkillsUSA Personal Skills/PDP SkillsUSA 4 Pillars TSA LEAP Updates to Student ICAP</p>

			<p>appropriate industry sector</p> <p>Describe the evolution of design drafting, including its technological progression and emerging trends.</p>	<p>Define employment expectations of entry-level employees in local employment situations (hiring requirements, basic job expectations, etc.)</p> <p>Describe the evolution of design drafting, including its technological progression. Research and present on an emerging design trend or application.</p>	
Basic Engineering and Technical Drawing Techniques	<p>Understand the application of drawing and design to multiple industries.</p> <p>Demonstrate basic drawing techniques for drafting or design purposes.</p> <p>Demonstrate an awareness of sustainability as it relates to design (e.g., materials used, social impact, feasibility in production and use, financial considerations, etc).</p> <p>Apply concepts of technical sketching appropriate to drafting and technical drawing occupations.</p>	<p>Understand how drafters and designers solve problems using the design process:</p> <ul style="list-style-type: none"> (A) Articulate the process for design drafting (B) Define design problems (C) Research and analyze information for design solutions <p>Perform basic technical sketching techniques which demonstrate:</p> <ul style="list-style-type: none"> (A) Types of sketch lines (B) Rays and perpendiculars (C) Proportions (D) Uniformity and composition 	<p>Identify common design applications and problems and list the steps required to solve a design problem.</p> <p>Identify factors (e.g., materials, cost, manufacturing processes) that influence design. Present how do designers and drafters address these design challenges.</p> <p>Create freehand sketches for a customer based on a design application or problem.</p> <p>Create freehand sketches of isometric and orthographic pictorials.</p> <p>Identify the differences between working and presentation drawings.</p>		

			<p>Understand mechanical part/component drawings. Student is expected to :</p> <p>(A) Create simple 2D and 3D drawings using appropriate industry standards.</p>		
Systems of Drawings and Industry Applications		Identify sources of information and resources for technical design and drafting.	Discuss the application of Orthographic projection standards and conventions use in technical documentations.	<p>Demonstrate application of ANSI ISO and discuss the need for standards and codes in design and drafting:</p> <ul style="list-style-type: none"> • Identify the components (e.g., title block, border, view arrangements) of a drawing. • Identify the standards related to working drawing view selection and placement. 	
Math Applications in Design		Apply mathematical skills and concepts used in the design and drafting process.	<p>Describe and apply mathematical concepts as they relate to design drafting.</p> <p>Understand the use of mathematical measurement systems for product design both in the United States and internationally.</p>	<p>Measure scaled lengths on technical drawings with the use of architectural and mechanical engineering scales, including:</p> <ul style="list-style-type: none"> • Add, subtract, multiply, and divide fractions, decimals, feet, and inches. • Identify equivalent forms of fractions (e.g., 1/8 " = 2/16 ", lowest common denominator) • Identify standard drafting scales (e.g., relationship between ratios and fractions). • Calculate the length of geometric shapes 	

				<ul style="list-style-type: none"> • Verify dimensions using estimation. Identify metric and imperial measurement systems: <ul style="list-style-type: none"> • English (fractional and decimal) measurement system • Metric (SI) measurement system • Identify symbols related to imperial measurement (e.g., 2'-3"). • Identify the Cartesian coordinate system in relation to CAD. 	
Basic Shapes of Products		Understand key elements of orthographic projection used in technical drawing applications.	<p>Understand the concepts of basic shapes and how principles of orthographic projection as used in industry to create function product design.</p> <p>Understand the principals and theory of orthographic projection.</p> <p>Identify drawing techniques for orthographic projection.</p> <p>Identify drawing techniques for isometric projection.</p>	<p>Demonstrate how various drawing techniques are used in the industry:</p> <ul style="list-style-type: none"> • Identify the common views used in orthographic projection • Demonstrate how 3-D objects are portrayed in a 2-D drawing • Distinguish between orthographic projection and isometric projection • Find and design parts around the origin 	
Dimensions for Technical Design		Understand the application of dimension	The student demonstrates use of a scale and its application	Add dimensions that comply with accepted industry standards to architectural or mechanical drawings (as appropriate):	

		as used in technical design.	to mechanical and architectural drawings. Synthesize simple dimensions into orthographic drawings: (A) Linear; (B) Angular; (C) Absolute and relative; and (D) Standards and conventions.	<ul style="list-style-type: none"> • Identify the purpose and rules of dimensioning. • Use basic ISO conventions for lines for manual and computer-based drawings (2D) • Identify the purpose of notes and annotations (e.g., about materials, processes, finishes) in architectural and mechanical drawings. • Create geometric relations and dimensions to sketches. • Construct planes, axes, and points. • Create reference geometry. • Combine drawing views and details to communicate the structure of 2D and 3D geometry. 	
Sectioning and Orthographic Drawing Standards		Understand and apply basic sectioning and orthographic drawing standards used in industry.	<p>Identify and apply drawing techniques associated with creating sectional views.</p> <p>Identify conventions in mechanical and architectural drawings.</p> <p>Compose multiple views of three-dimensional objects using orthographic projection.</p>	<p>Create technical sketches, geometric constructions, orthographic projections, pictorial/sectional views, dimension drawings, and apply lettering techniques:</p> <ul style="list-style-type: none"> • Prepare multi-view sketches of objects assigned by the instructor: <ul style="list-style-type: none"> ○ Select the Extrude, Revolve, Loft, and Sweep commands to create the base feature of an object. ○ Apply modeling techniques to feature creation such as holes, fillets, chamfers, shells, sweeps and lofts. ○ Choose the best construction method/feature for the part. 	

				<ul style="list-style-type: none"> ○ Identify errors/failures and correct them. ○ Demonstrate proper use of modifying and regenerating features such as delete, suppress, resume, reorder, change, modify, redefine, reroute, and regenerate. ● Apply material symbols to full and half section views. ● Explain the importance of materials notes on a drawing. 	
Basic Design Tools, Materials, and Safety		<p>Safely use tools, materials, equipment and other technology resources.</p> <p>Operate common computer hardware and identify basic software programs used within the industry.</p>	<p>Student demonstrates appropriate, safe use of design tools and equipment. Student is expected to:</p> <p>(A) Understand general laboratory safety rules and regulations when using tools, equipment and performing processes.</p> <p>(B) Demonstrate continuous awareness of potential hazards to self and others and respond appropriately.</p>	<p>Successfully pass a test on general laboratory safety and regulations with 100% accuracy (if appropriate). Consistently demonstrate safe practices in the classroom.</p> <p>Use technology appropriately according to school technology use policies.</p>	

			(C) Use technology appropriately and comply with school technology use policies.		
CAD Applications in Industry		<p>Understand the application of computer-aided design software programs used to create and design products. Analyze technology systems that are associated with selected areas of the designed world and to apply technological design skills in problem solving. Identify the function of computer models (e.g., visualization, model to working drawing). Operate common computer hardware and identify basic software programs used within the industry. Identify file management systems and practices (e.g., file organization, network navigation).</p>	<p>The student applies computer-aided design software programs to the design process. The student is expected to:</p> <p>(A) use computer-aided design (CAD) software to manage and organize project files in order to complete a design;</p> <p>(B) analyze the results of product testing in a simulated modeling environment; and</p> <p>(C) fabricate a prototype design</p>	<p>Prepare technical drawings with CAD software requiring students to set units, limits, layers, and utilize the software dimensioning tools (i.e in AutoCAD: Draw, Modify, and Dimension toolbars.) Demonstrate ability to use CAD software. Examples of assignments include:</p> <ul style="list-style-type: none"> • Explain how the filing system works in a CAD software application. Include how one would use appropriate naming and storage convention for files. • Create file translations to and from a variety of formats. (Examples include: DXF, IGES, STEP, STL.) • Create a drawing block library using computer design software. • Create, insert and edit blocks with AutoCAD or SolidWorks. • Manipulate views of the part by changing views, rotating, and zooming. • Create & apply materials to solid models. • Demonstrate how to control critical design dimensions and utilize global dimensions. • Find and evaluate mass properties. • Design/execute a 3D model: <ul style="list-style-type: none"> ○ Create mates between parts using basic geometric 	

