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CTSO Course Alignments: STEM Designers

Below you will find standards for the STEM Designers course aligned with competitive events from appropriate career and technical student organizations (CTSOs). Knowing the aligned events for your organization will allow you to have additional tools for teaching course standards, as well as increase student engagement and preparation in your CTSO activities. The final column recommends potential tools from other CTSO organizations. Even if your students are not participating in these organizations, available rubrics, tools, and materials can also add to the instructional resources at your disposal for best teaching your content.

Important to note: While the aligned activities below can be important tools in teaching course standards, it is important to note that events may not cover a standard in its entirety and should not be the sole instructional strategy used to address a standard.

	STANDARD	ALIGNED TSA COMPETITIVE EVENTS/PROGRAMS	OTHER POTENTIAL CTSO TOOLS & RESOURCES
1	Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. (TN Reading 3, 4)		• **FFA:** Agricultural Mechanics and Technology • **SkillsUSA**: Occupational Health and Safety
2	Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)		• **FFA:** Agricultural Mechanics and Technology • **SkillsUSA**: Occupational Health and Safety
3	Research the history of engineering using textbooks, the websites of professional societies, scholarly narratives, and explain how science, technology, and math have influenced its development. Create a timeline of important engineering milestones, noting the influence of science, technology, and math in the timeline. The timeline may be done via PowerPoint, Prezi, poster, or other graphic format. (TN Reading 1; TN Writing 2, 4, 7)	• **TSA**: Essays on Technology	

4	Research and illustrate the relationship between science, technology, engineering, and math using a flowchart, Venn diagram, or other graphic organizer. Provide an example of a design solution that incorporated at least three of the disciplines and articulate how they each contributed to the design. (TN Reading 1; TN Writing 2, 4)		
5	Research how engineers in various disciplines (such as civil, mechanical, electrical, chemical, biomedical, computer, agricultural, industrial, and aerospace) benefit society through the products and solutions they design. Write a paper arguing for the discipline that has benefited society the most. Illustrate the claim with specific products and benefits. (TN Reading 1; TN Writing 1, 4, 7)	• **TSA**: Career Prep	• **DECA:** Professional Selling Events • **FCCLA**: Advocacy • **HOSA**: Job Seeking Skills
6	Evaluate an existing engineering design, such as a local bridge or a famous building, providing evidence from exemplars and design rubrics to justify whether the design meets the specified criteria. Create a presentation explaining how the steps of the design process might have been used to create this feat of engineering, citing historical narratives, published interviews with the architects or engineers involved, and other informational resources. The typical steps of the design process include: identify the problem; identify criteria and specify constraints; brainstorm for possible solutions; research and generate ideas; explore alternative solutions; select an approach; write a design proposal, develop a model or prototype; test and evaluate; refine and improve; create or make a product; and communicate results. (TN Reading 3; TN Writing 1, 2, 4)	• **TSA**: Problem Solving, Structural Model, Technical Design	• **FCCLA**: Advocacy
7	Practice exploring alternative solutions in the engineering design process by creating two solutions for an engineering problem. Test each solution and record the test data. Analyze the test data to determine the differences in the quality for the solutions. Write a conclusion that that argues which solution is best and explains why. Support the explanation with specific evidence obtained from test results. For example, create a solar vehicle that is designed travel as fast as possible. The two solutions should have a single variable that is changed, for example drive and axle gear ratio, wheel size, or solar panel angle.(TN Reading 1, 3; TN Writing 1, 4, 7, 9; TN Math 8.SP)	• **TSA**: Dragster, Flight, Jr. Solar Sprint, Problem Solving, Structural Model, Technical Design	• **FCCLA**: Advocacy

8	Use the engineering design process and the practices of science and engineering (see specific practices below) to develop a solution for a given engineering challenge. Chronologically document the entire process in an engineering notebook. The engineering notebook should have bound, dated, and numbered pages. Use permanent ink to document notes. For example, design a balsa or basswood bridge that has the best performance ratio, maximum capacity divided by mass of the bridge. Tests can be done of various basic structure designs before creating a final design. This test data should be included in the engineering notebook. A hand or digital sketch should be made of the design. Pictures can be taken throughout the process and included in the engineering notebook. At minimum, address the following science and engineering practices: a. Using mathematics and computational thinking b. Designing solutions c. Engaging in argument from evidence d. Obtaining, evaluating, and communicating information (TN Reading 3; TN Writing 4)	• **TSA**: Dragster, Flight, Jr. Solar Sprint, Problem Solving, Structural Model, Technical Design	
9	Present a two-dimensional design idea using freehand sketching, manual drafting, and computer-aided drafting (such as SketchUp or AutoCad). Designs should be made to scale and include dimensions, labels, and notes. At least one of the designs presented should be an orthographic (multi-view) projection. Use basic dimensioning rules and apply understanding of the use of lines (e.g., object, hidden, center) to inform the design. Sketch principle views of a simple object from the top, bottom, front, back, left side, and right side. For example, create an orthographic projection of a CO_2 dragster or a floor plan for a home. (TN Reading 3, 4, 7; TN Writing 4; TN Math 8.G)	• **TSA**: Dragster, Flight	
10	Present a 3-D design idea using freehand sketching, manual drafting, and computer-aided drafting (such as SketchUp, SolidWorks, or Inventor). Designs should be made to scale and include dimensions, labels, and notes. Use basic dimensioning rules and apply understanding of the use of lines (e.g., object, hidden, center). *For example, convert the 2-D design in the activity in the previous standard into a 3-D design in the 3-D version of the software used to create the 2-D design.*(TN Reading 3, 4, 7; TN Writing 4; TN Math 8.G)	• **TSA**: Dragster, Flight	• **FBLA:** 3-D Animation
11	Create a scaled model of a design concept. A digital or manual drafting design should be made of this model prior to building or producing the model. For example, create a digital 3-D design of a product and use a 3-D printer to create a physical model of the design. If a 3-D printer is not available, build a model from materials provided in the class. (TN Reading 3, 4, 7; TN Writing 4; TN Math 8.G)	• **TSA**: Dragster, Flight, Go Green Manufacturing, Inventions and Innovations, Jr. Solar Sprint, Problem Solving, Structural Model, Technical Design	

12	Work in groups to solve a community or school problem by applying the engineering design process and the practices of science and engineering. Build a prototype, if feasible, and write a technical report detailing the problem, the design process used, and the solution proposed. Include an evaluation of the quality of the solution, and give a presentation to the class. Be able to justify the final design solution with supporting evidence from the process, including graphic representations and visual aids as appropriate. (TN Reading 1, 3, 4, 7, 9; TN Writing 2, 5, 6, 7, 8, 9, 10)	• **TSA**: Construction Challenge, Dragster, Environmental Focus, Flight, Go Green Manufacturing, Inventions and Innovations, Jr. Solar Sprint, Problem Solving, Structural Model, Technical Design	**FCCLA**: Advocacy
ALL	**CAN BE USED WITH ALL/MOST STANDARDS**		• **FCCLA**: Illustrated Talk, Career Investigation, Chapter in Review Display, Chapter in Review Portfolio, • **SkillsUSA**: Career Pathways Showcase, Job Skills Demonstration A, Job Skills Demonstration O, Prepared Speech, Extemporaneous Speaking, Chapter Display, Principles of Engineering Technology, Engineering Technology/Design