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CTSO Course Alignments: Engineering Design II

Below you will find standards for the Engineering Design II 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, 6)		• **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	In teams, research various sources to determine the differences between engineers and scientists. Create a brochure that would be appealing to middle school students to educate them on the differences between the roles and activities of engineers and scientists. As an extension activity, prepare a presentation, using the brochures, to present to local middle school students. (TN Reading 1, 5, 7, 9; TN Writing 2, 4, 6, 8)	• **TSA**: Career Preparation, Desktop Publishing, Prepared Presentation, Children's Stories	• **HOSA**: Job Seeking Skills, Prepared Speaking, Health Education

4	Research various engineering job responsibilities (such as research engineer, development engineer, testing engineer, design engineer, analysis engineer, systems engineer, manufacturing engineer, operations and maintenance engineer, technical support engineer, sales engineer, and engineering manager) and present the characteristics of each. Also, describe how these job responsibilities are applied in industry. Use a variety of sources to gather data, cite each source, and briefly explain why each source is reliable. (TN Reading 1, 5, 7, 9; TN Writing 2, 4, 6, 8)	• **TSA**: Career Preparation	• **FCCLA**: Job Interview, Career Investigation, Entrepreneurship, Interpersonal Communications • **HOSA**: Job Seeking Skills • **SkillsUSA**: Job Interview, Employment Application Process, Entrepreneurship
5	Write an explanatory text defining ethics in the context of engineering practice, comparing and contrasting ethical standards with morals, personal standards, and legal standards. Include reasons and examples why ethical standards take precedence over personal and legal standards in engineering (TN Reading 1, 2; TN Writing 2, 4, 7)		
6	Research print and electronic media to identify an issue related to ethics and engineering (for example, the decision to launch the space shuttle Challenger in cold temperatures). As a team, use the National Society of Professional Engineers (NSPE) Code of Ethics as a framework and develop a presentation displaying arguments on multiple sides of the selected issue or product. Teams should present their findings to the class and other audience members. (TN Reading 1, 2, 6, 7, 8, 9; TN Writing 1)	• **TSA**: Essays on Technology, Debating Technological Issues	• **FCCLA**: Advocacy • **HOSA**: Biomedical Debate
7	Prepare an explanatory text defining a system and identifying the components of a system (i.e., input, output, process, feedback) using a specific example such as: if an automobile is a system, the driver provides the input by turning the steering wheel to the left; the car converts input to process; the car then delivers the output by changing direction from straight to left. Convert the description to an illustration of the system. (TN Reading 1, 2, 4, 7; TN Writing 2, 4)	• **TSA**: Children's Stories, Promotional Graphics, Desktop Publishing	
8	Define, compare, and contrast processors and controllers; further, define, compare, and contrast microcontrollers, computer-based controllers, and programmable logic controllers, citing examples of how each is used. (TN Reading 1, 2, 4, 5; TN Writing 2, 4, 7)	• **TSA**: Animatronics, System Control Technology, VEX Robotics	
9	Define, compare, and contrast open-loop and closed-loop systems. Use responsible internet searches to find examples of both open- and closed-loop system diagrams, and explain why they are either open- or closed-loop. Use an online editing tool to develop an informational paper or infographic illustrate the difference between open- and closed-loop systems, supplying examples for each. (TN Reading 1, 2, 5, 7; TN Writing 2, 4, 6, 7, 8)		

10	Define fluid power; define, compare, and contrast the two categories of fluid power: pneumatic and hydraulic. Compare and contrast hydrostatics and hydrodynamics. Compare and contrast fluid flow rate and fluid velocity. Compare and contrast the three types of air pressure: atmospheric, gauge, and absolute. Demonstrate the use of the appropriate formulae for each concept. (TN Reading 1, 2, 4, 5; TN Writing 2, 4, 7; TN Math N-Q)		
11	Using various sources such as the internet and textbooks, research various applications of Bernoulli's principle and identify specific examples to demonstrate the principle. Develop and lead a lab activity to teach Bernoulli's principle to the class. (TN Reading 4, 5, 7)	• **TSA**: Future Technology Teacher, Prepared Presentation	• **HOSA**: Health Education, Prepared Speaking
12	Given a confined gas, explain the differences between the following laws: Boyle's, Charles', Avogadro's and Gay-Lussac's. Identify an online demonstration or prepare a demonstration of one (or more) of these laws and document each step of the law(s). Use an online editing tool to create a single written informative text with links to virtual demonstrations. (TN Reading 1, 2, 4, 5; TN Writing 2, 6, 7, 8; TN Math N-Q)		
13	Define the following and describe differences among terms dealing with strength and testing of materials (e.g., ductility, brittleness, hardness, elasticity, electrical conductivity, thermal conductivity, stress, strain, and shear stress). Explain why each factor is important to consider in a design. Research various sources and identify a demonstration of a design or material failing due to one of these characteristics; write an introduction to the topic and include the link to the video or demonstration. (TN Reading 1, 2, 4; TN Writing 2, 4, 7)		
14	As a team, use an online editing tool to develop an informational paper or infographic illustrating how raw materials are processed to make products and systems, and how each of these materials or products are used in society. Students should identify milestone developments (e.g., cast iron, paper, battery, and fiberglass) made possible after specific materials were developed. Metals, ceramics, polymers, and composites should be included. Select a material that is one of the most valuable materials ever discovered or manufactured, and use the online editing tool to prepare a persuasive paper supporting the claim. (TN Reading 1, 2, 5, 7, 9; TN Writing 1, 4, 6, 7, 8, 9)		• **FCCLA**: Advocacy • **HOSA**: Researched Persuasive Speaking

15	Define a projectile. Define, compare, and contrast kinematics and kinetics. Explain why a projectile travels along a parabolic curve. Solve fundamental projectile motion problems such as the initial horizontal velocity, initial vertical velocity, time for projectile to reach maximum height, maximum height reached by projectile, total flight time of projectile, distance projectile will travel horizontally, and firing angle. For example, given initial horizontal and vertical velocity of a projectile, use a graphical tool (i.e., Microsoft Excel or MATLAB) to graph the path of the projectile by programming equations defining the path. (TN Reading 3, 4, 7; TN Math N-Q, A-SEE, A-CED, F-IF, F-BF)		
16	Given a scenario of a stationary object with forces applied, construct a simple free body diagram, graphically illustrating the magnitude and direction of all forces acting upon the object. Demonstrate that the sum of the force vectors is equal to 0 for a stationary object. If the sum of the force vectors does not equal zero, explain the resulting motion of the object. (TN Reading 3, 4, 7; TN Writing 4; TN Math N-VM)		
17	Given a dataset, calculate mean, mode, median, standard deviation, and range using algebraic/statistical reasoning and engineering software such as Microsoft Excel. Generate a graphical representation of the dataset including results of these statistics in a format suitable for a technical report. (TN Reading 1, 3, 4; TN Writing 4; TN Math A-SSE, S-ID)		
18	In teams, prepare an informative report on the importance of quality management in the context of product design, process planning, and manufacturing implementation. For example, research and describe, through class discussion, the aspects of Joseph Juran's trilogy of quality planning, quality control, and quality improvement; sampled inspection during manufacturing and the use of the Taguchi method to minimize sampling; or the concept of 6-sigma in manufacturing. Prepare and deliver a presentation to the class, and incorporate visuals and information from print and electronic resources. (TN Reading 1, 2, 6, 7, 9; TN Writing 2, 4, 6, 7, 8, 9)	• **TSA**: Prepared Presentation	• **HOSA**: Prepared Speaking
19	Assess the impact of materials costs and manufacturing/construction costs in the development and determination of the best design solution. Apply techniques of engineering economics to guide design decisions. For example, understand how to use value and interest; cash flow diagrams; cash flow patterns; equivalence of cash flow patterns; unusual cash flows; and interest periods to make design solution decisions. (TN Reading 2, 3, 7, 9; TN Writing 4, 6; TN Math S-IC, F-IF)		• **FCCLA**: Life Event Planning **SkillsUSA**: Related Technical Math

20	Explore how teams are formed in order to design solutions to engineering problems. Using a scholarly database such as the Education Resources Information Center (ERIC), or searching on the websites of research institutions or other organizations, investigate a well-known team of engineers (for example, the team that raised the Costa Concordia shipwreck) and report to the class on how they collaborated to solve an engineering problem. (TN Reading 2, 4; TN Writing 2, 4, 7)	• **TSA**: Prepared Presentation	• **FCCLA**: Interpersonal Communications • **HOSA**: Prepared Speaking
21	As a team, identify a problem in the school or community; draft a problem statement to guide a project incorporating engineering concepts from at least three of the content sections outlined above (engineering economics must be included). Follow the engineering design process to solve the problem. Each team member will develop a paper following the format of a typical technical report (see components of the report below). Upon completion of the report, create and deliver a presentation for a CTSO event using appropriate citation conventions. Then, each team member will refine his/her report, incorporating feedback from the presentation. The written report should include, but is not limited to: a. Background b. Problem definition c. Design constraints d. Methodology e. Data analysis (e.g., charts, graphs, calculations) f. Cost analysis (using engineering economics concepts) g. Results/Problem solution (including engineering drawings) h. Conclusions and recommendations for future research (TN Reading 1, 3, 4, 5, 7, 9; TN Writing 2, 5, 6, 7, 8, 9)	• **TSA**: Prepared Presentation	• **FCCLA**: Advocacy • **HOSA**: Prepared Speaking
ALL	**CAN BE USED WITH ALL/MOST STANDARDS**	• **TSA**: Engineering Design, Manufacturing Prototype	• **FCCLA**: Illustrated Talk, Career Investigation, Chapter in Review Display, Chapter in Review Portfolio, • **HOSA**: Researched Persuasive Speaking • **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