

PARTNERSHIP FOR 21ST CENTURY SKILLS (P21)

In 2002, the Partnership for 21st Century Skills (now the Partnership for 21st Century Learning, or P21) was founded as a non-profit organization by a coalition that included members of the national business community, education leaders, and policymakers. To foster a national conversation on “the importance of 21st century skills for all students” and “position 21st century readiness at the center of US K-12 education.”

21st century skills comprise skills, abilities, and learning dispositions that have been identified as being required for success in 21st century society and workplaces by educators, business leaders, academics, and governmental agencies. This is part of a growing international movement focusing on the skills required for students to master in preparation for success in a rapidly changing, digital society. Many of these skills are also associated with deeper learning, which is based on mastering skills such as analytic reasoning, complex problem solving, and teamwork. TSA's competitive events provide a natural platform to highlight the leadership and 21st century capabilities of students.

TSA's leadership program engages participants to be the best member they can be, as they seek knowledge about themselves, the organization, and their community, while developing and demonstrating leadership and 21st century skills. Leadership and 21st century skills components are all specifically tailored for each individual competitive event, and are evaluated based on the official rules and rubrics.

- For example, in one competitive event team members might note the communication, collaboration, and teamwork skills they used to finalize their idea/design in their Plan of Work Log. While in another event, a brief discussion of leadership skills and/or 21st century skills that they developed or demonstrated while working on a project might be highlighted as part of an existing presentation/interview. Criteria will be included in the rubric to evaluate the leadership and 21st century skills documented or demonstrated within these components.

TSA's leadership program has recently been revised to incorporate the 21st century skills. LEAP has been replaced with a TSA leadership program that features the development of leadership and 21st century skills. All references to LEAP, required documentation, and LEAP interviews will no longer be part of the competitive events program, along with the LEAP Legacy Chapter program.

TSA will provide related resources to affiliated chapters through the updated TSA member database. Participation in the TSA competitive events develops leadership and 21st century skills in student members, skills essential for success in the job market.

- There will be other competitive events in which a student/team may naturally demonstrate leadership skills as part of the event. In these events, criteria will be included in the rubric to evaluate the overall leadership and 21st century skills demonstrated.

During the course of preparing for, and participating in a TSA competitive event, participants will study leadership and 21st century skills, and put them into practice. Participants will use the widely accepted leadership and 21st century skills resources, in addition to other resources provided on the TSA website, as they complete the competitive event leadership requirements for all TSA competitions.

TSA believes that acquiring leadership and 21st century skills is critical to the success of young people. The resources found on the TSA website provide TSA advisors with a source for teaching, and students with an opportunity to practice these crucial skills.

TSA's leadership program focuses on the below definitions of leadership and 21st century skills as developed through participation in middle and high school competitions:

Communication: a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior

Collaboration/Social Skills: to work jointly with others, especially in an intellectual endeavor

Initiative: energy or aptitude displayed in initiation of action

Problem Solving/Risk Taking: the process or act of finding a solution to a problem/the act or fact of doing something that involves danger or risk in order to achieve a goal

Critical Thinking (lateral thinking): a method for solving problems by making unusual or unexpected connections between ideas

Perseverance/Grit: continued effort to do or achieve something despite difficulties, failure, or opposition/ firmness of mind or spirit—unyielding courage in the face of hardship or danger

Creativity: the quality of being creative

Relationship Building/Teamwork: work done by several associates with each doing a part but all subordinating personal prominence to the efficiency of the whole

Dependability/Integrity: capable of being trusted or depended on/firm adherence to a code of especially moral or artistic values

Flexibility/Adaptability: characterized by a ready capability to adapt to new, different, or changing requirements

SOURCES

en.wikipedia.org/wiki/21st_century_skills

www.merriam-webster.com/dictionary/dictionary

www.edglossary.org/21st-century-skills

www.nea.org/home/34888.htm

www.lead4change.org/wp-content/uploads/2019/09/L4C_21stCenturySkillsAlignment_12-Track_2020.pdf

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) INTEGRATION



In recent years, not only educators, but also political, civic, and industry leaders have pushed for a greater emphasis on STEM education in schools. It is globally recognized that in order for any nation to be competitive, our future generations must develop competency in the 21st century skills afforded through STEM fields. TSA promotes a vision of students literate in these fields and believes competitions within this guide help make that vision a reality.

STEM education is not just an isolated and discreet acquisition of STEM knowledge and skills. Rather, STEM education demands the interdisciplinary application of these academic fields to improve outcomes in comprehension, communication, and problem solving. It is commonly accepted that the correlation between these STEM disciplines is interdependent. In order to develop a deep comprehension of one STEM area, one must simultaneously have an encompassing knowledge of another. For example, to design and engineer with any degree of complexity, one also must be familiar with technology, mathematics, and science. To practice science, one must have a firm knowledge of mathematics and technology.

Beyond necessity, there is another reason for STEM education in our schools and why the TSA program of activities inherently aligns with STEM goals. This reason revolves around teaching, learning, and what motivates our 21st century learners.

When students participate in TSA competitions, they find they must not only embrace the value of design when they compete, but they also must conceptualize, assess, and materialize that vision. Students may choose to work

collaboratively, depending upon the requirements of an event, or they may choose to work independently.

Irrespective of this choice, students develop the essential leadership and critical thinking skills to execute their strategy and align their intention with the STEM objectives set forth in this guide. STEM education is intrinsically exciting, rewarding, and meaningful for instructors and students alike. Through TSA competitive events, instructors challenge students to solve real-world problems through project-based learning and reflective experiences. This rigorous process supplements and complements classroom objectives by asking students to critically evaluate all aspects of their thought processes—from design, to communication, to execution.

Deserving of mention are three other essential areas embedded in most of TSA's competitive events—creativity, innovation, and ethics. Teaching students to think outside the box while considering the ethical consequences provides a global perspective essential to the success of our society. Through TSA competitions, students are asked to design creatively, while assessing the effects and impacts of what they develop.

The competitions found in this guide provide a hands-on venue for learning about STEM. By participating in TSA's competitive events, students gain a broader understanding of these content areas as they experience the satisfaction that comes from applying them to real life, problem-solving situations.

This section of the guide includes commonly accepted national standards for the areas of science, technology, and mathematics, as well as the Accreditation Board for Engineering and Technology (ABET, Inc.) criteria for accrediting higher education engineering programs.

NEXT GENERATION SCIENCE STANDARDS* (GRADES 9-12)**A. Structure and Properties of Matter**

1. **PS1-1:** Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
2. **PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
3. **PS1-8:** Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
4. **PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

B. Chemical Reactions

1. **PS1-2:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
2. **PS1-4:** Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
3. **PS1-5:** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
4. **PS1-6:** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
5. **PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

C. Forces and Interactions

1. **PS2-1:** Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
2. **PS2-2:** Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
3. **PS2-3:** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
4. **PS2-4:** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects
5. **PS2-5:** Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

D. Energy

1. **PS3-1:** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
2. **PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
3. **PS3-3:** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
4. **PS3-4:** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics)

5. **PS3-5:** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

E. Waves and Electromagnetic Radiation

1. **PS4-1:** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media
2. **PS4-2:** Evaluate questions about the advantages of using a digital transmission and storage of information.
3. **PS4-3:** Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
4. **PS4-4:** Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
5. **PS4-5:** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*

F. Structure, Function, and Information Processing

1. **LS1-1:** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells
2. **LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
3. **LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

G. Matter and Energy in Organisms and Ecosystems

1. **LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
2. **LS1-6:** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
3. **LS1-7:** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
4. **LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
5. **LS2-4:** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
6. **LS2-5:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

H. Interdependent Relationships in Ecosystems

1. **LS2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
2. **LS2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
3. **LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
4. **LS2-7:** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

5. **LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
6. **LS4-6:** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

I. Inheritance and Variation of Traits

1. **LS1-4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms
2. **LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring
3. **LS3-2:** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
4. **LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population

J. Natural Selection and Evolution

1. **LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
2. **LS4-2:** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
3. **LS4-3:** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait
4. **LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations

5. **LS4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

K. Space Systems

1. **ESS1-1:** Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
2. **ESS1-2:** Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
3. **ESS1-3:** Communicate scientific ideas about the way stars, over their life cycle, produce elements.
4. **ESS1-4:** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

L. History of Earth

1. **ESS1-5:** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
2. **ESS1-6:** Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
3. **ESS2-1:** Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

M. Earth's Systems

1. **ESS2-2:** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
2. **ESS2-3:** Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection

3. **ESS2-5:** Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
4. **ESS2-6:** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere..
5. **ESS2-7:** Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

N. Weather and Climate

1. **ESS2-4:** Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
2. **ESS3-5:** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

O. Human Sustainability

1. **ESS3-1:** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
2. **ESS3-2:** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
3. **ESS3-3:** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
4. **ESS3-4:** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*
5. **ESS3-6:** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

P. Engineering Design

1. **ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
2. **ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
3. **ETS1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
4. **ETS1-4:** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Although not formally aligned, this standards alignment of TSA competitive events has been developed in accordance with the Next Generation Science Standards (NGSS) model.

*The Next Generation Science Standards (NGSS) were developed by educators, content experts and policymakers, using as a guiding document the Framework for K-12 Science Education from the National Research Council. The Next Generation Science Standards is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and do not endorse it.

NEXT GENERATION SCIENCE STANDARDS (GRADES 9-12)		Standard Number	A-PS1-1	A-PS1-3	A-PS1-8	A-PS2-6	B-PS1-2	B-PS1-4	B-PS1-5	B-PS1-6	B-PS1-7	C-PS2-1	C-PS2-2	C-PS2-3	C-PS2-4	C-PS2-5	D-PS3-1	D-PS3-2	D-PS3-3	D-PS3-4	D-PS3-5	E-PS4-1	E-PS4-2	E-PS4-3	E-PS4-4	E-PS4-5
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Biotechnology Design																										
Board Game Design						X																				
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Children's Stories																										
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Computer Integrated Manufacturing (CIM)																										
Cybersecurity																										
Data Science and Analytics																										
Debating Technological Issues																										
Digital Video Production																										
Dragster Design																										
Engineering Design																										
Essays on Technology																										
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Flight Endurance																										
Forensic Science																										
Future Technology and Engineering Teacher																										
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Software Development																										
Structural Design and Engineering																										
System Control Technology																										
Technology Bowl																										
Technology Problem Solving																										
Transportation Modeling																										
Video Game Design																										
Webmaster																										

NEXT GENERATION SCIENCE STANDARDS (GRADES 9-12) – continued		Standard Number	F-LS1-1	F-LS1-2	F-LS1-3	G-LS1-5	G-LS1-6	G-LS1-7	G-LS2-3	G-LS2-4	G-LS2-5	H-LS2-1	H-LS2-2	H-LS2-6	H-LS2-7	H-LS2-8	H-LS4-6	L-LS1-4	L-LS3-1	L-LS3-2	L-LS3-3	J-LS4-1	J-LS4-2	J-LS4-3	J-LS4-4	J-LS4-5	
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NEXT GENERATION SCIENCE STANDARDS (GRADES 9-12) – continued

Event	Standard Number	K-ESS-1	K-ESS-2	K-ESS-3	K-ESS-4	L-ESS-5	L-ESS-6	L-ESS-2-1	M-ESS-2	M-ESS-3	M-ESS-5	M-ESS-6	M-ESS-7	N-ESS-2-4	N-ESS-3-5	O-ESS-3-1	O-ESS-3-2	O-ESS-3-3	O-ESS-3-4	O-ESS-3-6	P-ETS-1	P-ETS-2	P-ETS-3	P-ETS-4
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TECHNOLOGY CONTENT STANDARDS

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.
- Standard 2: Students will develop an understanding of the core concepts of technology.
- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technologies and other fields of study.
- Standard 4: Students will develop an understanding of the cultural, social, economic, and political aspects of technology.
- Standard 5: Students will develop an understanding of the effects of technology on the environment.
- Standard 6: Students will develop an understanding of the role of society in the development and use of technology.
- Standard 7: Students will develop an understanding of the influence of technology on history.
- Standard 8: Students will develop an understanding of the attributes of design.
- Standard 9: Students will develop an understanding of engineering design.
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- Standard 11: Students will develop the abilities to apply the design process.

- Standard 12: Students will develop the abilities to use and maintain technological products and systems.
- Standard 13: Students will develop the abilities to assess the impact of products and systems.
- Standard 14: Students will develop an understanding of and be able to select and use medical technologies.
- Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
- Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.
- Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.
- Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.
- Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.
- Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

These technology content standards are noted in *Standards for Technological Literacy: Content for the Study of Technology* (ITEEA/ITEA, 2000/2002/2007) and are used with permission. (www.iteea.org)

TECHNOLOGY CONTENT STANDARDS		TECHNOLOGY CONTENT STANDARDS																					
		Standard Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Event	Animatronics			X	X				X	X	X	X	X				X				X		
	Architectural Design		X	X	X	X	X	X	X	X	X	X	X	X				X			X		X
	Biotechnology Design				X	X	X			X	X	X	X				X						
	Board Game Design					X			X			X	X						X				
	Chapter Team											X											
	Children's Stories							X			X								X				
	Coding							X			X								X				
	Computer-Aided Design (CAD), Architecture					X		X	X	X	X	X	X								X		X
	Computer-Aided Design (CAD), Engineering					X		X	X	X	X	X	X								X		X
	Computer Integrated Manufacturing (CIM)		X	X			X	X	X	X	X	X	X										
	Cybersecurity																						
	Data Science and Analytics																						
	Debating Technological Issues				X												X						
	Digital Video Production				X				X			X	X										
	Dragster Design		X	X					X	X	X	X	X						X			X	
	Engineering Design		X	X	X	X	X	X	X	X	X	X	X						X			X	X
	Essays on Technology		X	X	X	X	X																
	Extemporaneous Speech		X	X	X				X										X				
	Fashion Design and Technology								X									X					
	Flight Endurance							X	X	X	X	X									X		
	Forensic Science				X					X					X								
	Future Technology and Engineering Teacher		X	X	X	X	X	X	X	X	X	X											
	Geospatial Technology																						
	Music Production								X										X				
	On Demand Video									X									X				
	Photographic Technology		X	X		X			X			X							X				
	Prepared Presentation		X	X															X				
	Promotional Design		X	X	X				X										X				
	Scientific and Technical Visualization (SciVis)		X		X				X			X							X				
	Software Development		X	X	X	X	X	X	X	X	X	X	X						X				
	Structural Design and Engineering		X	X					X	X	X	X	X						X				X
	System Control Technology								X	X	X	X	X						X				X
	Technology Bowl																		X				X
	Technology Problem Solving								X										X				X
	Transportation Modeling		X	X					X	X	X	X	X						X				X
	Video Game Design								X	X	X	X	X						X				X
	Webmaster								X	X	X	X	X						X				X

AP COMPUTER SCIENCE STANDARDS

A. Creative Development (CRD)

1. **CRD-1:** Incorporating multiple perspectives through collaboration improves computing innovations as they are developed.
 - a. **CRD-1.A:** Explain how computing innovations are improved through collaboration.
 - b. **CRD-1.B:** Explain how computing innovations are developed by groups of people.
 - c. **CRD-1.C:** Demonstrate effective interpersonal skills during collaboration.
2. **CRD-2:** Developers create and innovate using an iterative design process that is user-focused, that incorporates implementation/feedback cycles, and that leaves ample room for experimentation and risk-taking.
 - a. **CRD-2.A:** Describe the purpose of a computing innovation.
 - b. **CRD-2.B:** Explain how a program or code segment functions.
 - c. **CRD-2.C:** Identify input(s) to a program.
 - d. **CRD-2.D:** Identify output(s) produced by a program.
 - e. **CRD-2.E:** Develop a program using a development process.
 - f. **CRD-2.F:** Design a program and its user interface.
 - g. **CRD-2.G:** Describe the purpose of a code segment or program by writing documentation.
 - h. **CRD-2.H:** Acknowledge code segments used from other sources.
 - i. **CRD-2.I:** For errors in an algorithm or program:
 - i. Identify the error.
 - ii. Correct the error.
 - j. **CRD-2.J:** Identify inputs and corresponding expected outputs or behaviors that can be used to check the correctness of an algorithm or program.

B. Data (DAT)

1. **DAT-1:** The way a computer represents data internally is different from the way the data are interpreted and displayed for the user. Programs are used to translate data into a representation more easily understood by people.
 - a. **DAT-1.A:** Explain how data can be represented using bits.
 - b. **DAT-1.B:** Explain the consequences of using bits to represent data.
 - c. **DAT-1.C:** For binary numbers:
 - i. Calculate the binary (base 2) equivalent of a positive integer (base 10) and vice versa.
 - ii. Compare and order binary numbers.
 - d. **DAT-1.D:** Compare data compression algorithms to determine which is best in a particular context.
2. **DAT-2:** Programs can be used to process data, which allows users to discover information and create new knowledge.
 - a. **DAT-2.A:** Describe what information can be extracted from data.
 - b. **DAT-2.B:** Describe what information can be extracted from metadata.
 - c. **DAT-2.C:** Identify the challenges associated with processing data.
 - d. **DAT-2.D:** Extract information from data using a program.
 - e. **DAT-2.E:** Explain how programs can be used to gain insight and knowledge from data.

C. Algorithms and Programming (AAP)

1. **AAP-1:** To find specific solutions to generalizable problems, programmers represent and organize data in multiple ways.
 - a. **AAP-1.A:** Represent a value with a variable.
 - b. **AAP-1.B:** Determine the value of a variable as a result of an assignment.
 - c. **AAP-1.C:** Represent a list or string using a variable.

- d. **AAP-1.D:** For data abstraction:
 - i. Develop data abstraction using lists to store multiple elements.
 - ii. Explain how the use of data abstraction manages complexity in program code.
- 2. **AAP-2:** The way statements are sequenced and combined in a program determines the computed result. Programs incorporate iteration and selection constructs to represent repetition and make decisions to handle varied input values.
 - a. **AAP-2.A:** Express an algorithm that uses sequencing without using a programming language.
 - b. **AAP-2.B:** Represent a step-by-step algorithmic process using sequential code statements.
 - c. **AAP-2.C:** Evaluate expressions that use arithmetic operators.
 - d. **AAP-2.D:** Evaluate expressions that manipulate strings.
 - e. **AAP-2.E:** For relationships between two variables, expressions, or values:
 - i. Write expressions using relational operators.
 - ii. Evaluate expressions that use relational operators.
 - f. **AAP-2.F:** For relationships between Boolean values:
 - i. Write expressions using logical operators.
 - ii. Evaluate expressions that use logic operators.
 - g. **AAP-2.G:** Express an algorithm that uses selection without using a programming language.
 - h. **AAP-2.H:** For selection:
 - i. Write conditional statements.
 - ii. Determine the result of conditional statements.
 - i. **AAP-2.I:** For nested selection:
 - i. Write nested conditional statements.
 - ii. Determine the result of nested conditional statements.
 - j. **AAP-2.J:** Express an algorithm that uses iteration without using a programming language.
 - k. **AAP-2.K:** For iteration:
 - i. Write iteration statements.
 - ii. Determine the result or side effect of iteration statements.
 - l. **AAP-2.L:** Compare multiple algorithms to determine if they yield the same side effect or result.
 - m. **AAP-2.M:** For algorithms:
 - i. Create algorithms.
 - ii. Combine and modify existing algorithms.
 - n. **AAP-2.N:** For list operations:
 - i. Write expressions that use list indexing and list procedures.
 - ii. Evaluate expressions that use list indexing and list procedures.
 - o. **AAP-2.O:** For algorithms involving elements of a list:
 - i. Write iteration statements to traverse a list.
 - ii. Determine the result of an algorithm that includes list traversals.
 - p. **AAP-2.P:** For binary search algorithms:
 - i. Determine the number of iterations required to find a value in a data set.
 - ii. Explain the requirements necessary to complete a binary search.
- 3. **AAP-3:** Programmers break down problems into smaller and more manageable pieces. By creating procedures and leveraging parameters, programmers generalize processes that can be reused. Procedures allow programmers to draw upon existing code that has already been tested, allowing them to write programs more quickly and with more confidence.
 - a. **AAP-3.A:** For procedure calls:
 - i. Write statements to call procedures.
 - ii. Determine the result or effect of a procedure call.

- b. **AAP-3.B:** Explain how the use of procedural abstraction manages complexity in a program.
 - c. **AAP-3.C:** Develop procedural abstractions to manage complexity in a program by writing procedures.
 - d. **AAP-3.D:** Select appropriate libraries or existing code segments to use in creating new programs.
 - e. **AAP-3.E:** For generating random values:
 - i. Write expressions to generate possible values.
 - ii. Evaluate expressions to determine the possible results.
 - f. **AAP-3.F:** For simulations:
 - i. Explain how computers can be used to represent real-world phenomena or outcomes.
 - ii. Compare simulations with real-world contexts.
4. **AAP-4:** There exist problems that computers cannot solve, and even when a computer can solve a problem, it may not be able to do so in a reasonable amount of time.
- a. **AAP-4.A:** For determining the efficiency of an algorithm:
 - i. Explain the difference between algorithms that run in reasonable time and those that do not.
 - ii. Identify situations where a heuristic solution may be more appropriate.
 - b. **AAP-4.B:** Explain the existence of undecidable problems in computer science.

D. Computer Systems and Networks (CSN)

1. **CSN-1:** Computer systems and networks facilitate the transfer of data.
 - a. **CSN-1.A:** Explain how computing devices work together in a network.
 - b. **CSN-1.B:** Explain how the Internet works.
 - c. **CSN-1.C:** Explain how data are sent through the Internet via packets.

- d. **CSN-1.D:** Describe the differences between the Internet and the World Wide Web.
 - e. **CSN-1.E:** For fault-tolerant systems, like the Internet:
 - i. Describe the benefits of fault tolerance.
 - ii. Explain how a given system is fault-tolerant.
 - iii. Identify vulnerabilities to failure in a system.
2. **CSN-2:** Parallel and distributed computing leverage multiple computers to more quickly solve complex problems or process large data sets.
 - a. **CSN-2.A:** For sequential, parallel, and distributed computing:
 - i. a. Compare problem solutions.
 - ii. b. Determine the efficiency of solutions.
 - b. **CSN-2.B:** Describe benefits and challenges of parallel and distributed computing.

E. Impact of Computing (IOC)

1. **IOC-1:** While computing innovations are typically designed to achieve a specific purpose, they may have unintended consequences.
 - a. **IOC-1.A:** Explain how an effect of a computing innovation can be both beneficial and harmful.
 - b. **IOC-1.B:** Explain how a computing innovation can have an impact beyond its intended purpose.
 - c. **IOC-1.C:** Describe issues that contribute to the digital divide.
 - d. **IOC-1.D:** Explain how bias exists in computing innovations.
 - e. **IOC-1.E:** Explain how people participate in problem solving processes at scale.
 - f. **IOC-1.F:** Explain how the use of computing can raise legal and ethical concerns.
2. **IOC-2:** The use of computing innovations may involve risks to personal safety and identity.
 - a. **IOC-2.A:** Describe the risks to privacy from collecting and storing personal data on a computer system.

AP COMPUTER SCIENCE STANDARDS		Standard Number	Event
CRD-1-A	X	Animatronics	CRD-1-A
CRD-1-B		Architectural Design	CRD-1-B
CRD-1-C	X	Biotechnology Design	CRD-1-C
CRD-2-A		Board Game Design	CRD-2-A
CRD-2-B	X	Chapter Team	CRD-2-B
CRD-2-C		Children's Stories	CRD-2-C
CRD-2-D	X	Coding	CRD-2-D
CRD-2-E	X	Computer-Aided Design (CAD), Architecture	CRD-2-E
CRD-2-F		Computer-Aided Design (CAD), Engineering	CRD-2-F
CRD-2-G	X	Computer Integrated Manufacturing (CIM)	CRD-2-G
CRD-2-H	X	Cybersecurity	CRD-2-H
CRD-2-I	X	Data Science and Analytics	CRD-2-I
CRD-2-J		Debating Technological Issues	CRD-2-J
CRD-2-K		Digital Video Production	CRD-2-K
CRD-2-L		Dragster Design	CRD-2-L
CRD-2-M		Engineering Design	CRD-2-M
CRD-2-N		Essays on Technology	CRD-2-N
CRD-2-O		Extemporaneous Speech	CRD-2-O
CRD-2-P		Fashion Design and Technology	CRD-2-P
CRD-2-Q		Flight Endurance	CRD-2-Q
CRD-2-R		Forensic Science	CRD-2-R
CRD-2-S		Future Technology and Engineering Teacher	CRD-2-S
CRD-2-T		Geospatial Technology	CRD-2-T
CRD-2-U		Music Production	CRD-2-U
CRD-2-V		On Demand Video	CRD-2-V
CRD-2-W		Photographic Technology	CRD-2-W
CRD-2-X		Prepared Presentation	CRD-2-X
CRD-2-Y		Promotional Design	CRD-2-Y
CRD-2-Z	X	Scientific and Technical Visualization (SciVIs)	CRD-2-Z
CRD-3-A	X	Software Development	CRD-3-A
CRD-3-B		Structural Design and Engineering	CRD-3-B
CRD-3-C	X	System Control Technology	CRD-3-C
CRD-3-D		Technology Bowl	CRD-3-D
CRD-3-E		Technology Problem Solving	CRD-3-E
CRD-3-F		Transportation Modeling	CRD-3-F
CRD-3-G	X	Video Game Design	CRD-3-G
CRD-3-H		Webmaster	CRD-3-H
DAT-1-A			DAT-1-A
DAT-1-B			DAT-1-B
DAT-1-C			DAT-1-C
DAT-1-D			DAT-1-D
DAT-1-E	X		DAT-1-E
DAT-2-A			DAT-2-A
DAT-2-B			DAT-2-B
DAT-2-C			DAT-2-C
DAT-2-D			DAT-2-D
DAT-2-E			DAT-2-E

AP COMPUTER SCIENCE STANDARDS – continued		Standard Number	AAP-1A	AAP-1B	AAP-1C	AAP-1D	AAP-2A	AAP-2B	AAP-2C	AAP-2D	AAP-2E	AAP-2F	AAP-2G	AAP-2H	AAP-2I	AAP-2J	AAP-2K	AAP-2L	AAP-2M	AAP-2N	AAP-2O	AAP-2P	AAP-3A
Event																							
Animatronics			X																				X
Architectural Design																							
Biotechnology Design																							
Board Game Design																							
Chapter Team																							
Children's Stories																							
Coding			X	X	X	X		X	X	X	X	X		X	X		X	X					
Computer-Aided Design (CAD), Architecture																							
Computer-Aided Design (CAD), Engineering																							
Computer Integrated Manufacturing (CIM)																							
Cybersecurity																							
Data Science and Analytics																							
Debating Technological Issues																							
Digital Video Production																							
Dragster Design																							
Engineering Design																							
Essays on Technology																							
Extemporaneous Speech																							
Fashion Design and Technology																							
Flight Endurance																							
Forensic Science																							
Future Technology and Engineering Teacher																							
Geospatial Technology																							
Music Production																							
On Demand Video																							
Photographic Technology																							
Prepared Presentation																							
Promotional Design																							
Scientific and Technical Visualization (SciVis)			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Software Development			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Structural Design and Engineering																							
System Control Technology								X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Technology Bowl																							
Technology Problem Solving																							
Transportation Modeling																							
Video Game Design			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Webmaster																							X

AP COMPUTER SCIENCE STANDARDS – continued		Standard Number	AP-3-B	AP-3-C	AP-3-D	AP-3-E	AP-3-F	AP-4-A	AP-4-B	CSN-1-A	CSN-1-B	CSN-1-C	CSN-1-D	CSN-1-E	CSN-2-A	CSN-2-B	IOC-1-A	IOC-1-B	IOC-1-C	IOC-1-D	IOC-1-E	IOC-1-F	IOC-2-A
Event																							
Animatronics			X																				
Architectural Design																							
Biotechnology Design																							
Board Game Design																							
Chapter Team																							
Children's Stories																							
Coding								X															
Computer-Aided Design (CAD), Architecture																							
Computer-Aided Design (CAD), Engineering																							
Computer Integrated Manufacturing (CIM)																							
Cybersecurity							X			X	X	X	X	X								X	X
Data Science and Analytics																							
Debating Technological Issues																							
Digital Video Production																							
Dragster Design																							
Engineering Design																							
Essays on Technology																							
Extemporaneous Speech																							
Fashion Design and Technology																							
Flight Endurance																							
Forensic Science																							
Future Technology and Engineering Teacher																							
Geospatial Technology																							
Music Production																							
On Demand Video																							
Photographic Technology																							
Prepared Presentation																							
Promotional Design																							
Scientific and Technical Visualization (SciVis)			X	X	X		X																
Software Development			X	X	X			X															
Structural Design and Engineering																							
System Control Technology			X	X	X			X															
Technology Bowl																							
Technology Problem Solving																							
Transportation Modeling																							
Video Game Design			X	X	X																		
Webmaster			X		X																		

AP COMPUTER SCIENCE: COMPUTATIONAL THINKING PRACTICES**Practice 1: Computational Solution Design**

Design and evaluate computational solutions for a purpose.

- A. Investigate the situation, context, or task.
- B. Determine and design an appropriate method or approach to achieve the purpose.
- C. Explain how collaboration affects the development of a solution.
- D. Evaluate solution options.

Practice 2: Algorithms and Program Development

Develop and implement algorithms.

- A. Represent algorithmic processes without using a programming language.
- B. Implement and apply an algorithm.

Practice 3: Abstraction in Program Development

Develop programs that incorporate abstractions.

- A. Generalize data sources through variables.
- B. Use abstraction to manage complexity in a program.
- C. Explain how abstraction manages complexity.

Practice 4: Code Analysis

Evaluate and test algorithms and programs.

- A. Explain how a code segment or program functions.
- B. Determine the result of code segments.
- C. Identify and correct errors in algorithms and programs, including error discovery through testing.

Practice 5: Computing Innovations

Investigate computing innovations.

- A. Explain how computing systems work.
- B. Explain how knowledge can be generated from data.
- C. Describe the impact of a computing innovation.
- D. Describe the impact of gathering data.
- E. Evaluate the use of computing based on legal and ethical factors.

Practice 6: Responsible Computing

Contribute to an inclusive, safe, collaborative, and ethical computing culture.

- A. Collaborate in the development of solutions.
- B. Use safe and secure methods when using computing devices.
- C. Acknowledge the intellectual property of others.

AP COMPUTER SCIENCE: COMPUTATIONAL THINKING PRACTICES																						
Event	Standard Number	1A	1B	1C	1D	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	5D	5E	6A	6B	6C	
Animatronics			X	X					X				X						X			
Architectural Design		X	X		X																	
Biotechnology Design		X	X		X											X						
Board Game Design																						
Chapter Team																						
Children's Stories																						
Coding							X		X	X	X	X	X	X	X				X			
Computer-Aided Design (CAD), Architecture		X	X		X																	
Computer-Aided Design (CAD), Engineering		X	X		X																	
Computer Integrated Manufacturing (CIM)																						
Cybersecurity				X	X				X			X	X					X	X			X
Data Science and Analytics		X	X		X			X														
Debating Technological Issues																						
Digital Video Production																						
Dragster Design																						
Engineering Design																						
Essays on Technology																						
Extemporaneous Speech																						
Fashion Design and Technology																						
Flight Endurance																						
Forensic Science																						
Future Technology and Engineering Teacher																						
Geospatial Technology		X		X											X		X	X	X			X
Music Production																						
On Demand Video																						
Photographic Technology																						
Prepared Presentation																						
Promotional Design		X	X		X																	X
Scientific and Technical Visualization (SciVis)		X	X	X	X				X				X						X			X
Software Development		X	X	X	X		X		X	X			X	X	X	X			X	X		X
Structural Design and Engineering																						
System Control Technology		X	X	X	X		X						X		X	X			X	X		X
Technology Bowl																						
Technology Problem Solving																						
Transportation Modeling																						
Video Game Design			X	X	X				X				X									X
Webmaster			X	X	X				X				X						X	X		X

ISTE STANDARDS FOR STUDENTS – 2016 INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION

1. Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.

- a. articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes
- b. build networks and customize their learning environments in ways that support the learning process
- c. use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways
- d. understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies

2. Digital Citizen

Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

- a. cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world
- b. engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices
- c. demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property
- d. manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online

3. Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

- a. plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits
- b. evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources
- c. curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions
- d. build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions

4. Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

- a. know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems
- b. select and use digital tools to plan and manage a design process that considers design constraints and calculated risks
- c. develop, test and refine prototypes as part of a cyclical design process
- d. exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems

e. Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

- a. formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions
- b. collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making
- c. break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving
- d. understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions

6. Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

- a. choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication
- b. create original works or responsibly repurpose or remix digital resources into new creations
- c. communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations
- d. publish or present content that customizes the message and medium for their intended audiences

7. Global Collaborator

Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

- a. use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning
- b. use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints
- c. contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal
- d. explore local and global issues and use collaborative technologies to work with others to investigate solutions

Although not formally aligned, this standards alignment of TSA competitive events has been developed in accordance with the ISTE Standards for Students framework. The ISTE Standards for Students are a framework for teaching and learning in the digital age and are adopted by schools, districts, states locally, nationally and internationally. The ISTE Standards for Students are a registered trademark of International Society for Technology in Education (ISTE). ISTE was not involved in the production of this product and does not endorse, support, or sponsor it.

ISTE STANDARDS FOR STUDENTS																														
Event	Standard Number	1a	1b	1c	1d	2a	2b	2c	2d	3a	3b	3c	3d	4a	4b	4c	4d	5a	5b	5c	5d	6a	6b	6c	6d	7a	7b	7c	7d	
Animatronics		X			X									X	X	X	X				X	X	X	X				X		
Architectural Design		X	X							X	X	X	X	X	X	X	X	X					X	X	X	X			X	X
Biotechnology Design		X								X	X	X	X	X	X	X	X	X	X				X	X	X	X			X	X
Board Game Design																														
Chapter Team																														
Children's Stories																														
Coding					X																X								X	
Computer-Aided Design (CAD), Architecture														X	X	X	X	X					X	X	X	X				
Computer-Aided Design (CAD), Engineering														X	X	X	X	X					X	X	X	X				
Computer Integrated Manufacturing (CIM)																														
Cybersecurity		X	X		X	X	X																						X	X
Data Science and Analytics		X								X	X	X											X	X	X	X			X	X
Debating Technological Issues																														
Digital Video Production		X	X		X					X	X	X		X			X	X					X	X	X	X		X	X	X
Dragster Design																														
Engineering Design																														
Essays on Technology																														
Extemporaneous Speech																														
Fashion Design and Technology																														
Flight Endurance																														
Forensic Science																														
Future Technology and Engineering Teacher																														
Geospatial Technology		X								X	X	X		X			X	X					X	X	X	X			X	X
Music Production		X			X					X	X	X		X			X	X					X	X	X	X			X	X
On Demand Video		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Photographic Technology		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Prepared Presentation		X								X	X	X		X			X	X					X	X	X	X			X	X
Promotional Design		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Scientific and Technical Visualization (SciVis)		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Software Development		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Structural Design and Engineering																														
System Control Technology		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Technology Bowl																														
Technology Problem Solving																														
Transportation Modeling																														
Video Game Design		X			X					X	X	X		X			X	X					X	X	X	X			X	X
Webmaster		X			X					X	X	X		X			X	X					X	X	X	X			X	X

CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS (Accreditation Board for Engineering and Technology [ABET, Inc.]

Engineering programs must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (A) through (K) plus any additional outcomes that may be articulated by the program.

- A. An ability to apply knowledge of mathematics, science and engineering
- B. An ability to design and conduct experiments, as well as to analyze and interpret data
- C. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- D. An ability to function on multidisciplinary teams
- E. An ability to identify, formulate and solve engineering problems
- F. An understanding of professional and ethical responsibility
- G. An ability to communicate effectively
- H. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context
- I. A recognition of the need for, and an ability to engage in life-long learning
- J. A knowledge of contemporary issues
- K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The outcomes listed are found in the *2016-2017 Criteria for Accrediting Engineering Programs* and used with permission from the Engineering Accreditation Commission of ABET, Inc.

Access the [2018-2019 Criteria for Accrediting Engineering Programs](#) for the latest outcomes.

(The outcomes were designed for higher education engineering programs, but they are relevant for middle school and high school level engineering-related courses.)

CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS (ABET, INC.)

Standard	Event	Standard Letter	A	B	C	D	E	F	G	H	I	J	K
A. An ability to apply knowledge of mathematics, science and engineering	Animatronics		X			X	X						X
	Architectural Design		X		X	X	X	X	X	X	X	X	X
	Biotechnology Design		X	X	X	X	X	X	X	X	X	X	X
	Board Game Design		X		X		X		X		X	X	X
	Chapter Team									X	X		
	Children's Stories				X	X		X	X		X		
	Coding		X		X	X			X				X
	Computer-Aided Design (CAD), Architecture		X				X		X	X	X	X	X
	Computer-Aided Design (CAD), Engineering		X				X		X	X	X	X	X
	Computer Integrated Manufacturing (CIM)		X	X	X	X	X	X	X	X	X	X	X
	Cybersecurity					X						X	
	Data Science and Analytics		X	X					X	X			X
	Debating Technological Issues								X	X			
	Digital Video Production								X	X	X		
B. An ability to design and conduct experiments, as well as to interpret data	Dragster Design		X	X	X		X	X	X	X			X
	Engineering Design		X	X	X	X	X	X	X	X	X	X	X
	Essays on Technology		X	X				X	X	X		X	
	Extemporaneous Speech							X	X	X			
	Fashion Design and Technology					X				X			
	Flight Endurance		X	X	X		X	X	X	X	X		X
	Forensic Science		X	X					X			X	
	Future Technology and Engineering Teacher		X		X			X	X	X		X	
	Geospatial Technology			X	X	X		X	X	X		X	
	Music Production								X	X			
	On Demand Video					X		X	X	X			
	Photographic Technology		X					X	X	X	X	X	X
	Prepared Presentation								X	X	X		
	Promotional Design		X						X	X			
C. An ability to design a system, component, or process to meet desired needs	Scientific and Technical Visualization (SciVis)			X	X	X		X	X	X			X
	Software Development		X	X	X	X	X	X	X	X	X	X	X
	Structural Design and Engineering		X	X	X	X	X	X	X	X	X	X	X
	System Control Technology		X	X	X	X	X	X	X	X	X	X	X
	Technology Bowl		X	X	X		X			X		X	X
	Technology Problem Solving		X		X								
	Transportation Modeling		X	X	X	X	X	X	X	X			X
	Video Game Design				X	X	X	X	X	X	X		
	Webmaster				X	X	X	X	X	X			

**NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS (NCTM)
PRINCIPLES AND STANDARDS FOR SCHOOL MATHEMATICS****A. Numbers and operations**

1. Understand numbers, ways of representing numbers, relationships among numbers and number systems
2. Understand meanings of operations and how they relate to one another
3. Compute fluently and make reasonable estimates

B. Algebra

1. Understand patterns, relations, and functions
2. Represent and analyze mathematical situations and structures using algebraic symbols
3. Use mathematical models to represent and understand quantitative relationships
4. Analyze change in various contexts

C. Geometry

1. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
2. Specify locations and describe spatial relationships using coordinate geometry and other representational systems
3. Apply transformations and use symmetry to analyze mathematical situations
4. Use visualization, spatial reasoning and geometric modeling to solve problems

D. Measurement

1. Understand measurable attributes of objects and the units, systems and processes of measurement
2. Apply appropriate techniques, tools and formulas to determine measurements

E. Data analysis and probability

1. Formulate questions that can be addressed with data and collect, organize and display relevant data to answer them
2. Select and use appropriate statistical methods to analyze data
3. Develop and evaluate inferences and predictions that are based on data
4. Understand and apply basic concepts of probability

F. Problem solving

1. Build new mathematical knowledge through problem solving
2. Solve problems that arise in mathematics and in other contexts
3. Apply and adapt a variety of appropriate strategies to solve problems
4. Monitor and reflect on the process of mathematical problem solving

G. Reasoning and proof

1. Recognize reasoning and proof as fundamental aspects of mathematics
2. Make and investigate mathematical conjectures
3. Develop and evaluate mathematical arguments and proofs
4. Select and use various types of reasoning and methods of proof

H. Communication

1. Organize and consolidate mathematical thinking through communication
2. Communicate mathematical thinking coherently and clearly to peers, teachers and others
3. Analyze and evaluate the mathematical thinking and strategies of others
4. Use the language of mathematics to express mathematical ideas precisely

I. Connections

1. Recognize and use connections among mathematical ideas
2. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
3. Recognize and apply mathematics in contexts outside of mathematics

J. Representation

1. Create and use representations to organize, record, and communicate mathematical ideas
2. Select, apply, and translate among mathematical representations to solve problems
3. Use representations to model and interpret physical, social and mathematical phenomena

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Choosing a career is one of the more important decisions made in life. This section of the guide may help students focus on career areas that appeal to them in the world of work, as well as show them how their involvement in TSA's program of activities has the ability to guide them toward those areas.

Career Clusters® are categories of similar occupations and industries. The Career Clusters® chart was developed by the U.S. Department of Education to organize career planning and help schools better prepare learners for their futures. The Career Clusters® chart offers general information about career categories and work opportunities prominent in those areas. The *TSA Competitions and the Career Clusters®* grid illustrates the interconnectedness between individual TSA competitions and the 16 Career Clusters®. Use these together as a starting point to help your students become informed about careers and develop a plan to reach their life goals.



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16 CAREER CLUSTERS®

A. AGRICULTURE, FOOD & NATURAL RESOURCES

- Agribusiness Systems
- Animal Systems
- Environmental Service Systems
- Food Products & Processing Systems
- Natural Resources Systems
- Plant Systems
- Power, Structural & Technical Systems Architecture & Construction

B. ARCHITECTURE & CONSTRUCTION

- Construction
- Design/Pre-Construction
- Maintenance/Operations

C. ARTS, A/V TECHNOLOGY & COMMUNICATIONS

- A/V Technology & Film
- Journalism & Broadcasting
- Performing Arts
- Printing Technology
- Telecommunications
- Visual Arts

D. BUSINESS MANAGEMENT & ADMINISTRATION

- Administrative Support
- Business Information Management
- General Management
- Human Resources Management
- Operations Management

E. EDUCATION & TRAINING

- Administration & Administrative Support
- Professional Support Services
- Teaching/Training

F. FINANCE

- Accounting
- Banking Services
- Business Finance
- Insurance
- Securities & Investments

G. GOVERNMENT & PUBLIC ADMINISTRATION

- Foreign Service
- Governance
- National Security
- Planning
- Public Management & Administration
- Regulation
- Revenue & Taxation

H. HEALTH SCIENCES

- Biotechnology Research & Development
- Diagnostic Services
- Health Informatics
- Support Services
- Therapeutic Services

I. HOSPITALITY & TOURISM

- Lodging
- Recreation, Amusements & Attractions
- Restaurants & Food/Beverage Services
- Travel & Tourism

J. HUMAN SERVICES

- Consumer Services
- Counseling & Mental Health Services
- Early Childhood Development & Services
- Family & Community Services
- Personal Care Services

K. INFORMATION TECHNOLOGY

- Information Support & Services
- Network Systems
- Programming & Software Development
- Web & Digital Communications

L. LAW, PUBLIC SAFETY, CORRECTIONS & SECURITY

- Correction Services
- Emergency & Fire Management Services
- Law Enforcement Services
- Legal Services
- Security & Protective Services

M. MANUFACTURING

- Health, Safety & Environmental Assurance
- Logistics & Inventory Control
- Maintenance, Installation & Repair
- Manufacturing Production Process Dev.
- Production
- Quality Assurance

N. MARKETING

- Marketing Communications
- Marketing Management
- Marketing Research
- Merchandising
- Professional Sales

O. SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

- Engineering & Technology
- Science & Mathematics

P. TRANSPORTATION, DISTRIBUTION & LOGISTICS

- Facility & Mobile Equipment Maintenance
- Health, Safety & Environmental Management
- Logistics Planning & Management Services
- Sales & Service
- Transportation Operations
- Transportation Systems/Infrastructure
- Planning, Management & Regulation
- Warehousing & Distribution Center Operations

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More information on the Career Clusters® can be found at www.careertech.org.



TSA COMPETITIONS AND THE 16 CAREER CLUSTERS®																	
Event	Cluster letter	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Animatronics				X						X				X			
Architectural Design		X	X		X		X	X	X	X	X	X		X		X	
Biotechnology Design		X	X						X					X		X	X
Board Game Design			X	X		X					X			X	X	X	X
Chapter Team					X			X					X				
Children's Stories				X		X					X					X	
Coding												X				X	
Computer-Aided Design (CAD), Architecture			X	X								X	X				
Computer-Aided Design (CAD), Engineering			X	X								X	X				
Computer Integrated Manufacturing (CIM)						X			X			X		X		X	X
Cybersecurity		X			X	X	X	X	X	X	X	X	X			X	X
Data Science and Analytics		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Debating Technological Issues									X						X	X	
Digital Video Production				X						X		X				X	
Dragster Design											X						
Engineering Design		X	X	X	X	X	X	X	X	X			X	X	X	X	X
Essays on Technology				X	X												
Extemporaneous Speech				X	X	X		X							X		
Fashion Design and Technology				X										X			
Flight Endurance																	X
Forensic Science													X				X
Future Technology and Engineering Teacher						X						X					
Geospatial Technology		X	X					X		X			X			X	X
Music Production				X								X			X		
On Demand Video				X								X			X		
Photographic Technology		X		X		X			X	X		X		X	X	X	
Prepared Presentation				X	X			X									
Promotional Design				X							X						
Scientific and Technical Visualization (SciVis)				X								X				X	
Software Development				X								X	X	X		X	X
Structural Design and Engineering			X					X		X			X	X		X	X
System Control Technology													X			X	
Technology Bowl		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Technology Problem Solving		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transportation Modeling											X						
Video Game Design				X								X					
Webmaster				X								X					