TSA'S LEADERSHIP PROGRAM

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 5-8)

A. Structure and Properties of Matter

1. **PS1-1:** Develop models to describe the atomic composition of simple molecules and extended structures.
2. **PS1-3:** Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
3. **PS1-4:** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

B. Chemical Reactions

1. **PS1-2:** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
2. **PS1-5:** Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
3. **PS1-6:** Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*

C. Forces and Interactions

1. **PS2-1:** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*
2. **PS2-2:** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
3. **PS2-3:** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
4. **PS2-4:** Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
5. **PS2-5:** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

D. Energy

1. **PS3-1:** Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
2. **PS3-2:** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system
3. **PS3-3:** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*
4. **PS3-4:** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
5. **PS3-5:** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

E. Waves and Electromagnetic Radiation

1. **PS4-1:** Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
2. **PS4-2:** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
3. **PS4-3:** Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

F. Structure, Function, and Information Processing

1. **LS1-1**: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
2. **LS1-2:** Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.

3. **LS1-3:** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
4. **LS1-8:** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

G. Matter and Energy in Organisms and Ecosystems

1. **LS1-6:** Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
2. **LS1-7:** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
3. **LS2-1:** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
4. **LS2-3:** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
5. **LS2-4:** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

H. Interdependent Relationships in Ecosystems

1. **LS2-2:** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
2. **LS2-5:** Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

I. Growth, Development, and Reproduction of Organisms

1. **LS1-4:** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
2. **LS1-5:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
3. **LS3-1:** Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
4. **LS3-2:** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
5. **LS4-5:** Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.

J. Natural Selection and Adaptations

1. **LS4-1:** Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
2. **LS4-2:** Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
3. **LS4-3:** Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
4. **LS4-4:** Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment
5. **LS4-6:** Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

K. Space Systems

1. **ESS1-1:** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons
2. **ESS1-2:** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system
3. **ESS1-3:** Analyze and interpret data to determine scale properties of objects in the solar system

L. History of Earth

1. **ESS1-4:** Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
2. **ESS2-2:** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales
3. **ESS2-3**: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions

M. Earth's Systems

1. **ESS2-1:** Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
2. **ESS2-4:** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
3. **ESS3-1:** Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

N. Weather and Climate

1. **ESS2-5:** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
2. **ESS2-6: D**evelop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates
3. **ESS3-5:** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

O. Human Impacts

1. **ESS3-2:** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
2. **ESS3-3:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
3. **ESS3-4:** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

P. Engineering Design

1. **ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
2. **ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
3. **ETS1-3:** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
4. **ETS1-4:** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Although not formally aligned, this standards alignment of TSA competitve 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

Event	Standard Number	A-PS1-1	A-PS1-3	A-PS1-4	B-PS1-2	B-PS1-5	B-PS1-6	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	F-LS1-1	F-LS1-2	F-LS1-3	F-LS1-8	G-LS1-6	G-LS1-7	G-LS2-1	G-LS2-3	G-LS2-4	H-LS2-2	H-LS2-5
Biotechnology		X																			X										
Career Prep																															
Challenging Technology Issues																															
Chapter Team																															
Children's Stories																															
Coding																															
Community Service Video																															
Computer-Aided Design (CAD) Foundations																															
Construction Challenge																															
Cybersecurity																															
Data Science and Analytics																									X		X	X	X		
Digital Photography																															
Dragster									X							X															
Electrical Applications																															
Essays on Technology																															
Flight									X				X																		
Forensic Technology																															
Foundations of Information Technology (FIT)																															
Inventions and Innovations																															
Junior Solar Sprint									X					X	X																
Leadership Strategies																															
Mass Production																															
Mechanical Engineering																															
Medical Technology		X																			X	X									
Microcontroller Design																															
Off the Grid																															
Prepared Speech																															
Problem Solving																															
Promotional Marketing																															
STEM Animation																															
Structural Engineering																															
System Control Technology																															
Tech Bowl																															
Technical Design																															
Video Game Design																															
Website Design																															

NEXT GENERATION SCIENCE STANDARDS – continued

Event	Standard Number	I-LS1-4	I-LS1-5	I-LS3-1	I-LS3-2	I-LS4-5	J-LS4-1	J-LS4-2	J-LS4-3	J-LS4-4	J-LS4-6	K-ESS1-1	K-ESS1-2	K-ESS1-3	L-ESS2-2	L-ESS2-3	L-ESS2-4	M-ESS2-1	M-ESS2-4	M-ESS3-1	N-ESS2-5	N-ESS2-6	N-ESS3-5	O-ESS3-2	O-ESS3-3	O-ESS3-4	P-ETS1-1	P-ETS1-2	P-ETS1-3	P-ETS1-4
Biotechnology																														
Career Prep																														
Challenging Technology Issues																														
Chapter Team																														
Children's Stories																														
Coding																														
Community Service Video																														
Computer-Aided Design (CAD) Foundations																														
Construction Challenge																														
Cybersecurity																										X	X	X	X	
Data Science and Analytics																								X	X					
Digital Photography																														
Dragster																										X	X	X	X	
Electrical Applications																														
Essays on Technology																						X								
Flight																											X	X		
Forensic Technology																														
Foundations of Information Technology (FIT)																										X	X	X	X	
Inventions and Innovations																														
Junior Solar Sprint																												X		
Leadership Strategies																														
Mass Production																													X	
Mechanical Engineering																											X			
Medical Technology																														
Microcontroller Design																														
Off the Grid																										X				
Prepared Speech																														
Problem Solving																											X			
Promotional Marketing																														
STEM Animation																														
Structural Engineering																										X		X	X	
System Control Technology																														
Tech Bowl																														
Technical Design																														
Video Game Design																														
Website Design																														

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, 2000/2002/2007) and are used with permission. (www.iteea.org)

TECHNOLOGY CONTENT STANDARDS

Event / Standard Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Biotechnology	X	X	X	X	X	X				X		X	X		X					
Career Prep														X	X	X	X	X	X	X
Challenging Technology Issues				X	X	X							X	X	X	X	X	X	X	X
Chapter Team											X									
Children's Stories								X			X						X			
Coding	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Community Service Video			X					X				X					X			
Computer-Aided Design (CAD) Foundations					X			X	X	X	X	X	X							
Construction Challenge								X			X						X			
Cybersecurity	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			
Digital Photography								X	X		X	X					X			
Dragster								X			X					X				
Electrical Applications								X	X	X	X	X	X	X	X	X	X	X	X	X
Essays on Technology	X	X	X	X	X	X							X							
Flight			X					X	X	X	X							X		
Forensic Technology			X							X				X						
Foundations of Information Technology (FIT)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Inventions and Innovations				X	X		X	X	X	X				X	X	X	X	X	X	X
Junior Solar Sprint			X					X	X	X	X	X	X			X		X		
Leadership Strategies										X										
Mass Production					X	X		X	X	X	X	X	X						X	
Mechanical Engineering								X	X	X	X	X				X				X
Medical Technology				X	X	X			X	X	X			X						
Microcontroller Design	X	X	X	X				X	X		X	X	X			X				
Off the Grid	X	X	X		X			X	X	X	X	X			X		X	X		
Prepared Speech	X	X	X	X	X		X										X			
Problem Solving								X		X	X									
Promotional Marketing								X	X		X	X								
STEM Animation	X		X					X			X						X			
Structural Engineering										X	X									
System Control Technology			X					X	X	X	X	X				X		X	X	X
Tech Bowl													X	X	X	X	X	X	X	X
Technical Design								X	X		X									
Video Game Design								X	X		X						X			
Website Design								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 descisions 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: E**xpress 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 distribted 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 innovaions 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

Event	Standard Number	CRD-1.A	CRD-1.B	CRD-1.C	CRD-2.A	CRD-2.B	CRD-2.C	CRD-2.D	CRD-2.E	CRD-2.G	CRD-2.H	CRD-2.I	CRD-2.J	DAT-1.A	DAT-1.B	DAT-1.C	DAT-1.D	DAT-2.A	DAT-2.B	DAT-2.C	DAT-2.D	DAT-2.E
Biotechnology																						
Career Prep																						
Challenging Technology Issues																						
Chapter Team																						
Children's Stories																						
Coding					X	X	X		X		X	X	X									
Community Service Video																						
Computer-Aided Design (CAD) Foundations																						
Construction Challenge																						
Cybersecurity		X	X	X								X										
Data Science and Analytics		X	X	X													X	X	X	X	X	X
Digital Photography																						
Dragster																						
Electrical Applications																						
Essays on Technology																						
Flight																						
Forensic Technology																						
Foundations of Information Technology (FIT)																						
Inventions and Innovations																						
Junior Solar Sprint																						
Leadership Strategies																						
Mass Production																						
Mechanical Engineering																						
Medical Technology																						
Microcontroller Design			X	X		X	X		X	X	X	X										
Off the Grid																						
Prepared Speech																						
Problem Solving																						
Promotional Marketing																						
STEM Animation		X		X	X		X	X	X		X	X	X									
Structural Engineering																						
System Control Technology		X	X	X	X		X	X		X	X	X	X									
Tech Bowl																						
Technical Design																						
Video Game Design		X		X			X	X	X	X	X	X	X									
Website Design		X		X			X	X	X	X	X	X	X									

AP COMPUTER SCIENCE STANDARDS – continued

Event	Standard Number	AAP-1.A	AAP-1.B	AAP-1.C	AAP-1.D	AAP-2.A	AAP-2.B	AAP-2.C	AAP-2.D	AAP-2.E	AAP-2.F	AAP-2.G	AAP-2.H	AAP-2.I	AAP-2.J	AAP-2.K	AAP-2.L	AAP-2.M	AAP-2.N	AAP-2.O	AAP-2.P	AAP-3.A
Biotechnology																						
Career Prep																						
Challenging Technology Issues																						
Chapter Team																						
Children's Stories																						
Coding		X	X	X			X	X	X	X	X		X	X	X	X	X					
Community Service Video																						
Computer-Aided Design (CAD) Foundations																						
Construction Challenge																						
Cybersecurity									X							X	X					
Data Science and Analytics																						
Digital Photography																						
Dragster																						
Electrical Applications																						
Essays on Technology																						
Flight																						
Forensic Technology																						
Foundations of Information Technology (FIT)																						
Inventions and Innovations																						
Junior Solar Sprint																						
Leadership Strategies																						
Mass Production																						
Mechanical Engineering																						
Medical Technology																						
Microcontroller Design		X	X	X			X	X	X	X	X		X	X	X	X	X	X	X			X
Off the Grid																						
Prepared Speech																						
Problem Solving																						
Promotional Marketing																						
STEM Animation		X	X	X			X		X	X	X		X	X	X	X	X		X			X
Structural Engineering																						
System Control Technology		X	X	X			X	X	X	X	X		X	X	X	X	X	X	X			X
Tech Bowl																						
Technical Design																						
Video Game Design		X	X	X			X	X	X	X	X		X	X	X	X	X	X	X			X
Website Design		X	X	X			X		X				X	X					X			

AP COMPUTER SCIENCE STANDARDS – continued																						
Event	Standard Number	AAP-3.B	AAP-3.C	AAP-3.D	AAP-3.E	AAP-3.F	AAP-4.A	AAP-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
Biotechnology																						
Career Prep																						
Challenging Technology Issues																						
Chapter Team																						
Children's Stories																						
Coding								X														
Community Service Video																						
Computer-Aided Design (CAD) Foundations																						
Construction Challenge																						
Cybersecurity								X	X				X			X	X			X	X	X
Data Science and Analytics																X	X			X	X	
Digital Photography																						
Dragster																						
Electrical Applications																						
Essays on Technology																						
Flight																						
Forensic Technology																						
Foundations of Information Technology (FIT)									X	X	X	X	X							X	X	X
Inventions and Innovations																						
Junior Solar Sprint																						
Leadership Strategies																						
Mass Production																						
Mechanical Engineering																						
Medical Technology																						
Microcontroller Design		X	X	X			X						X			X	X				X	
Off the Grid																						
Prepared Speech																						
Problem Solving																						
Promotional Marketing																						
STEM Animation						X																
Structural Engineering																						
System Control Technology		X	X	X			X						X			X	X				X	
Tech Bowl																						
Technical Design																						
Video Game Design		X	X	X	X		X															
Website Design																						

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
Biotechnology	X	X	X	X														X		X
Career Prep																				
Challenging Technology Issues																				
Chapter Team																				
Children's Stories																				
Coding			X	X		X				X	X	X						X		X
Community Service Video	X	X	X	X																
Computer-Aided Design (CAD) Foundations	X	X		X																
Construction Challenge																				
Cybersecurity	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		
Digital Photography																				
Dragster																				
Electrical Applications																				
Essays on Technology																				
Flight																				
Forensic Technology																				
Foundations of Information Technology (FIT)													X	X	X	X	X			
Inventions and Innovations																				
Junior Solar Sprint																				
Leadership Strategies																				
Mass Production																				
Mechanical Engineering																				
Medical Technology	X	X	X	X														X		X
Microcontroller Design	X	X	X	X						X	X	X						X		
Off the Grid																				
Prepared Speech																				
Problem Solving																				
Promotional Marketing																				
STEM Animation			X							X	X	X						X		X
Structural Engineering																				
System Control Technology	X	X	X	X						X	X	X						X		
Tech Bowl																				
Technical Design	X	X	X	X														X		
Video Game Design			X			X				X	X	X						X		X
Website Design			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
   tudents 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

5. **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
Biotechnology		X								X	X	X	X	X	X		X	X	X								X	X
Career Prep																													
Challenging Technology Issues																													
Chapter Team																													
Children's Stories																													
Coding				X																							X	
Community Service Video				X						X		X	X				X					X	X	X	X			X	X
Computer-Aided Design (CAD) Foundations				X										X	X							X	X	X	X				
Construction Challenge																													
Cybersecurity			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
Digital Photography					X					X																			
Dragster																													
Electrical Applications																													
Essays on Technology																													
Flight																													
Forensic Technology																													
Foundations of Information Technology (FIT)						X	X																						
Inventions and Innovations																													
Junior Solar Sprint																													
Leadership Strategies																													
Mass Production																													
Mechanical Engineering																													
Medical Technology		X			X					X	X	X	X	X	X	X	X	X	X					X	X			X	X
Microcontroller Design		X			X					X		X	X	X	X	X	X	X	X	X	X	X		X				X	X
Off the Grid																													
Prepared Speech																													
Problem Solving																													
Promotional Marketing								X														X	X	X					
STEM Animation		X			X			X						X								X	X	X	X			X	X
Structural Engineering																													
System Control Technology		X			X					X		X	X	X	X	X	X	X	X	X	X	X		X					X
Tech Bowl																													
Technical Design														X			X			X									
Video Game Design		X			X			X																				X	
Website Design		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 demonstrate that their students attain the following outcomes:

A. An ability to apply knowledge of mathematics, science, and engineering
B. An ability to design and conduct experiments, as well as to interpret data
C. An ability to design a system, component, or process to meet desired needs
D. An ability to function on multi-disciplinary 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 in global and social contexts
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 *2008-2009 Criteria for Accrediting Engineering Programs* and used with permission from the Engineering Accreditation Commission of ABET, Inc. The outcomes were designed for higher education engineering programs but are relevant for both 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 B. An ability to design and conduct experiments, as well as to interpret data C. An ability to design a system, component, or process to meet desired needs D. An ability to function on multi-disciplinary 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 in global and social contexts 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.tools necessary for engineering practice.	Biotechnology		X	X	X	X	X	X	X	X		X	
	Career Prep		X					X	X	X			
	Challenging Technology Issues								X	X	X	X	
	Chapter Team									X	X		
	Children's Stories				X	X		X	X		X		
	Coding				X								
	Community Service Video					X			X		X		
	Computer-Aided Design (CAD) Foundations		X		X		X		X	X	X	X	X
	Construction Challenge		X			X		X	X				
	Cybersecurity			X	X	X	X	X	X	X	X	X	
	Data Science and Analytics		X	X				X	X			X	
	Digital Photography							X	X	X		X	X
	Dragster		X	X	X		X	X	X				X
	Electrical Applications		X	X	X		X			X		X	X
	Essays on Technology		X	X	X	X	X	X	X	X	X		
	Flight		X	X	X		X	X	X		X	X	X
	Forensic Technology		X	X					X			X	
	Foundations of Information Technology (FIT)		X	X	X	X	X	X	X	X	X	X	X
	Inventions and Innovations		X		X	X	X		X		X		
	Junior Solar Sprint		X	X	X		X		X				X
	Leadership Strategies							X	X		X		
	Mass Production		X	X	X	X	X	X	X	X			
	Mechanical Engineering		X	X	X	X	X	X	X	X	X	X	X
	Medical Technology		X	X	X	X	X	X	X	X	X	X	X
	Microcontroller Design		X		X				X				X
	Off the Grid				X	X	X	X	X	X		X	X
	Prepared Speech								X	X	X	X	
	Problem Solving		X	X	X		X		X				
	Promotional Marketing		X					X	X				
	STEM Animation				X	X	X		X			X	X
	Structural Engineering		X	X	X	X	X		X				X
	System Control Technology		X	X	X	X	X	X	X				X
	Tech Bowl		X	X	X		X			X		X	X
	Technical Design				X		X	X	X				
	Video Game Design				X	X			X		X		
	Website Design				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

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS (NCTM) PRINCIPLES AND STANDARDS FOR SCHOOL MATHEMATICS

Event / Standard Number	A1	A2	A3	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	E1	E2	E3	E4	F1	F2	F3	F4	G1	G2	G3	G4	H1	H2	H3	H4	I1	I2	I3	J1	J2	J3
Biotechnology												X	X													X		X		X		X	X		X
Career Prep																																			
Challenging Technology Issues																										X	X	X	X		X	X			
Chapter Team																																			
Children's Stories																																			
Coding																																			
Community Service Video			X																													X			
Computer-Aided Design (CAD) Foundations								X	X		X	X	X																				X		
Construction Challenge												X	X							X															
Cybersecurity														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	X
Digital Photography																				X						X		X							
Dragster							X	X	X		X	X	X						X	X															
Electrical Applications												X	X	X	X			X	X													X			
Essays on Technology			X	X						X	X	X	X		X				X																
Flight		X	X	X				X			X	X	X			X	X	X	X	X	X		X		X	X	X					X			
Forensic Technology														X		X				X															
Foundations of Information Technology (FIT)														X	X	X	X			X															
Inventions and Innovations																																			
Junior Solar Sprint	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X					X	X	X			
Leadership Strategies																				X												X			
Mass Production												X	X						X	X															
Mechanical Engineering						X	X	X			X	X							X	X															
Medical Technology	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Microcontroller Design																																			
Off the Grid												X	X						X	X															
Prepared Speech																																			
Problem Solving												X	X					X	X	X															
Promotional Marketing												X	X																						
STEM Animation	X		X		X														X	X					X			X			X			X
Structural Engineering		X	X				X	X		X	X	X	X			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	X			X	X	X	X	X	X		X	X	X	X	X			X	X	X			
Tech Bowl								X	X		X	X	X						X	X									X		X	X			
Technical Design								X	X	X	X	X	X						X								X		X		X	X		X	
Video Game Design												X							X	X						X	X								
Website Design																			X	X									X	X				

TSA AND CAREERS

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.

PATHWAYS TO COLLEGE & CAREER READINESS
CareerClusters®

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

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

PATHWAYS TO COLLEGE & CAREER READINESS
CareerClusters®

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
Biotechnology									X							X	
Career Prep		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Challenging Technology Issues		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chapter Team				X			X					X					X
Children's Stories			X		X					X					X		
Coding												X		X		X	
Community Service Video			X						X		X				X		
Computer-Aided Design (CAD) Foundations		X	X								X	X					
Construction Challenge		X											X				
Cybersecurity					X							X	X			X	
Data Science and Analytics		X				X	X	X			X	X	X	X	X	X	X
Digital Photography			X												X		
Dragster													X		X	X	X
Electrical Applications			X										X				
Essays on Technology			X	X			X					X		X			
Flight													X		X	X	
Forensic Technology												X			X		X
Foundations of Information Technology (FIT)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Inventions and Innovations			X	X							X	X	X	X	X	X	
Junior Solar Sprint													X		X	X	
Leadership Strategies		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mass Production		X	X		X	X				X				X		X	
Mechanical Engineering		X							X			X	X			X	
Medical Technology								X		X		X			X		
Microcontroller Design												X				X	
Off the Grid		X	X														
Prepared Speech			X	X	X		X		X			X		X			
Problem Solving		X									X		X		X		
Promotional Marketing			X								X			X			
STEM Animation			X								X	X			X		
Structural Engineering		X										X			X	X	X
System Control Technology		X										X	X		X	X	X
Tech Bowl					X						X				X		
Technical Design		X	X								X	X			X		X
Video Game Design			X								X	X			X		X
Website Design			X								X	X			X		