Technology Foundations

8402 18 weeks

8403 36 weeks

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Course Description

Suggested Grade Level: 9 or 10 or 11

In this hands-on technology education course, students use tools to build and control objects and systems using engineering design. Students will learn about materials, energy, and engineering processes. Students design, create, and assess innovations, systems, and products to learn about how and why technology works. This introductory course is a prerequisite for Technology Transfer and Technology Assessment.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

Task Number	8403	8402	Tasks/Competencies
Exploring Technology Foundations			
39	⊕	⊕	Define technology.
40	⊕	⊕	Explain the characteristics and scope of technology.
41	⊕	⊕	Identify the core concepts of technology.
42	⊕	⊕	Describe the basic systems model.
43	⊕	⊕	Distinguish between an open- and closed-loop system.
44	⊕	⊕	Explain how systems may have varying outputs.
45	⊕	⊕	List technological resources and their function in a system.
46	⊕	⊕	Explain what process does in a system.
47	⊕	⊕	Identify the seven resources for a particular technological system.
48	⊕	⊕	Describe an engineering design process that is used to design a product.

49	⊕	⊕	Identify common technological processes that convert materials or energy to produce an output or solution.
50	⊕	⊕	Describe the core areas of STEM.
51	⊕	⊕	Use the Pythagorean theorem during a problem-solving activity
52	⊕	⊕	Identify career opportunities in a variety of technological contexts.
Understanding Technological Systems			
53	⊕	⊕	Illustrate the concept of a technological system.
54	⊕	⊕	Distinguish between a system and a subsystem.
55	⊕	⊕	Analyze the effects of technological systems on society and the environment.
Analyzing Consumer Products			
56	⊕	⊕	Define consumer.
57	⊕	⊕	Explain how human factors engineering applies to product design.
58	⊕	○	Describe ways consumer products have shaped society and the environment.
59	⊕	○	Select a consumer product to analyze.
60	⊕	○	Collect product data.
61	⊕	○	Reverse engineer a product.
62	⊕	○	Analyze how a product works, using mathematical and scientific concepts.
63	⊕	○	Describe an innovation that would improve a product.
64	⊕	○	Draw illustrations of an improved product.
65	⊕	⊕	Construct models of an improved product.
66	⊕	⊕	Represent 3D objects on a two-dimensional surface.
67	⊕	○	Create a display or multimedia presentation of an improved product, emphasizing STEM concepts.

68	⊕	○	Present recorded information about a product using multimedia.
Using Materials as a Technological Resource			
69	⊕	⊕	Classify materials as either natural or synthetic.
70	⊕	⊕	Classify materials according to the major types.
71	⊕	⊕	Explain how material resources are processed.
72	⊕	⊕	Create a detailed diagram for producing a designed product/model/prototype.
73	⊕	⊕	Use tools, machines, and processes to change materials to produce a designed product.
74	⊕	⊕	Select the best material for a specific design application.
75	⊕	⊕	Predict the outcomes of some technological processes.
76	⊕	○	Develop a design using recycled materials.
Using Energy as a Technological Resource			
77	⊕	⊕	Identify the two types of energy.
78	⊕	⊕	Analyze forms of energy.
79	⊕	⊕	Identify the sources of energy used with technological devices.
80	⊕	⊕	Model the use of energy with mechanical, electrical, fluidic, and thermal systems.
81	⊕	○	Map the path of current and emerging energy supplies from their source to end-users.
82	⊕	⊕	Compare methods to conserve energy through technological modification.
Controlling an Electronic System			
83	⊕	⊕	Analyze a problem whose solution uses electronic controls.
84	⊕	⊕	Describe the different methods for using electronically controlled devices.

85	⊕	⊕	Use engineering design to solve an identified problem using an electronically controlled device .
86	⊕	⊕	Construct a functional model of an electronically controlled device.
87	⊕	⊕	Control a device with a microcontroller.
88	⊕	⊕	Present information about an electronically controlled device.
Designing a Product			
89	⊕	○	Evaluate the needs and wants of people in school, home, community, or world that could be met through technological change.
90	⊕	○	Write a statement that defines a problem, challenge, need, or opportunity.
91	⊕	○	Collect information about a technological problem to be solved.
92	⊕	○	Generate potential solutions to the problem, challenge, need, or opportunity.
93	⊕	○	Select the best solution for a problem.
94	⊕	○	Construct a prototype of the best solution.
95	⊕	○	Evaluate the solution by comparing it with the problem statement, constraints, and criteria.
96	⊕	○	Present the final product.

Legend: ⊕Essential ○Non-essential ⊖Omitted

Curriculum Framework

Exploring Technology Foundations

Task Number 39

Define technology.

Definition

Definition should include technology as human inventions, systems, and processes which affect our environment and needs and wants.

Process/Skill Questions

- What are examples of technology?
- When did technology begin?
- How does technology affect one's everyday life?

ITEEA National Standards

1. The Characteristics and Scope of Technology

Task Number 40

Explain the characteristics and scope of technology.

Definition

Explanation should include

- the meaning of STEM
- the fact that people use things from nature to both create and use technology to accomplish goals and satisfy needs
- the eight contexts/areas of technology
    - automation, computation, artificial intelligence and robotic technologies
    - manufacturing technologies
    - transportation and logistics technologies
    - energy and power technologies
    - information and communication technologies
    - construction of the built environment
    - medical and health-related technologies
    - agriculture and biotechnologies.

Process/Skill Questions

- How do science, technology, engineering, and mathematics differ?
- What do science, technology, engineering, and mathematics have in common?

- What are the ways in which technology evolves?

ITEEA National Standards

1. The Characteristics and Scope of Technology

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

17. Information and Communication Technologies

18. Transportation Technologies

19. Manufacturing Technologies

20. Construction Technologies

TSA Competitive Events

Biotechnology Design

Transportation Modeling

Task Number 41

Identify the core concepts of technology.

Definition

Identification should include

- systems
- resources
- requirements
- optimization and trade-offs
- processes
- controls
- habits of mind
- criteria and constraints.

Process/Skill Questions

- What is technological literacy?
- What makes the study of technology important?
- What is the difference between criteria and constraints?
- What is the difference between a natural and a human-designed system?
- What are some habits of mind?
- What do optimization and trade-offs refer to?

Task Number 42

Describe the basic systems model.

Definition

Description should include aspects of the following:

- Input
- Process
- Output
- Feedback

Process/Skill Questions

- What is the basic systems model?
- What are the main components of a systems model?
- What do we use system models for?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 43

Distinguish between an open- and closed-loop system.

Definition

Distinguishing should include

- defining *open-loop* as a system that is not affected by the output

- defining *closed-loop* as a system that is affected by the output and contains automatic feedback.

Process/Skill Questions

- What is feedback?
- What are some examples of each type of system?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 44

Explain how systems may have varying outputs.

Definition

Explanation should include the concept that outputs of technology systems may be positive or negative and expected or unexpected.

Process/Skill Questions

- What are some examples of expected positive outputs?
- What are some examples of expected negative outputs?
- What are some examples of unexpected positive outputs?
- What are some examples of unexpected negative outputs?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 45

List technological resources and their function in a system.

Definition

List should include

- machines and other tools
- energy
- materials
- people
- time
- information
- capital.

Process/Skill Questions

- What are the seven technology resources?
- How are people a resource?
- What is capital?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 46

Explain what process does in a system.

Definition

Explanation should include that processes act on resources to produce output.

Process/Skill Questions

- What part do machines and other tools play in a process?
- How does a material change in a process?
- How does time affect processes?
- What information might be needed for processes to take place?
- What capital might be needed for a process to take place?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 47

Identify the seven resources for a particular technological system.

Definition

Identification should include examples of each type of resource (i.e., tools, energy, materials, people, time, information, capital).

Process/Skill Questions

- What are the seven technology resources used in the given system?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 48

Describe an engineering design process that is used to design a product.

Definition

Description should include the documentation of each step of the design process used

- define the problem
- brainstorm possibilities to solve the problem
- explore solutions
- generate the solution chosen
- test the solution
- evaluate the results of the test.

Process/Skill Questions

- What are the steps of an engineering design process?
- How do the steps of an engineering design process relate to each other?
- How does an engineering design system differ from the scientific method?

ITEEA National Standards

9. Engineering Design

TSA Competitive Events

Engineering Design

Task Number 49

Identify common technological processes that convert materials or energy to produce an output or solution.

Definition

Identification should include processes such as

- heating materials
- separating materials
- combining materials
- controlling technologies (e.g., electronic devices, bicycles, hole punch)
- transforming energy.

Process/Skill Questions

- What are the different technology processes?
- How is motion converted into energy? What are some examples?
- What are the safety guidelines for each process?
- When might outputs be desirable or undesirable?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

2. The Core Concepts of Technology

Task Number 50

Describe the core areas of STEM.

Definition

Description should include

- science as the study of the natural world
- technology as the study of the human-designed world
- engineering as the use of science and mathematics to design technology solutions
- mathematics as the study of numbers, shapes, and patterns.

Process/Skill Questions

- What is technology?
- What is science?
- What is engineering?
- How is mathematics used in technology?
- What is the relationship among the components of STEM?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

Engineering Design

Task Number 51

Use the Pythagorean theorem during a problem-solving activity

Definition

Use should include the following concepts:

- Triangles are used as a strong shape in construction.
- The Pythagorean theorem is used for right triangles.
- The hypotenuse is the side of the triangle that does not have a right angle.
- The square root of the hypotenuse is equal to the square root of the sum of the squares of the other two sides ($a^2 + b^2 = \sqrt{c^2}$).

Process/Skill Questions

- What is a right triangle?
- Why might we need to know the hypotenuse?
- What triangles might we use in constructing things?
- What does square of a number mean?
- What does square root of a number mean?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 52

Identify career opportunities in a variety of technological contexts.

Definition

Identification may include careers related to the eight contexts of technology.

Process/Skill Questions

- What are some career opportunities in transportation?
- What are some career opportunities in communications?
- What are some career opportunities in manufacturing?
- What are some career opportunities in construction?
- What are some career opportunities in energy?
- What are some career opportunities in agricultural?
- What are some career opportunities in medical and health-related technologies?
- What are some career opportunities in automation, computation, AI, and robotics?
- What are some career opportunities in biotechnology?
- What are some resources for information on careers in Virginia? Nationwide? How might technology skills prepare one for a job of the future?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

TSA Competitive Events

Understanding Technological Systems

Task Number 53

Illustrate the concept of a technological system.

Definition

Illustration should include the concept that a technological system is composed of inputs, processes, outputs, and feedback and show how the technological system processes use resources to accomplish a task to produce the output.

Process/Skill Questions

- How might you diagram a system?
- What are the different symbols used in flowcharts?
- Where do technology resources enter the systems model?
- How might public opinion influence the emerging systems of hybrid vehicles?
- When might people determine that a system needs improving?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 54

Distinguish between a system and a subsystem.

Definition

Distinction should include that a system is a combination of parts working together to accomplish a goal, and a subsystem is a complete system that is an integral part of a larger system.

Process/Skill Questions

- What are some examples of systems and subsystems in each of the eight contexts of technology?
- What is the difference between a natural system and a technological system?
- What are some technological systems in the classroom? Why are they considered systems?
- What are some technological systems in your home? Why are they considered systems?
- What are the inputs of a flashlight? The process? The outputs?
- Why is packaging a subsystem part of a system?
- How is manufacturing a system with subsystems?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 55

Analyze the effects of technological systems on society and the environment.

Definition

Analysis should include

- social
- cultural
- economic
- environmental
- ethical
- political
- aesthetic
- psychological.

Process/Skill Questions

- How have various transportation subsystems changed the relationship among family members? The relationship between individuals and employment? The relationship between society and nature?
- What effects has biotechnology had on agriculture in recent years?
- How is it possible for a technological system to have both a positive and negative effect?

- What are some positive and negative effects of the following technological systems or components of these systems: transportation (e.g., the interstate highway system), communication (e.g., smartphones), and construction (e.g., bridges)? What are some psychological effects of these things?
- How has the speed of communication affected the acceptance of new technologies?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

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Analyzing Consumer Products

Task Number 56

Define consumer.

Definition

Definition should include the concept of a consumer as an entity that purchases and uses a product or service.

Process/Skill Questions

- What are examples of consumers?
- What is the difference between a product and a service? What are examples of each?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

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Task Number 57

Explain how human factors engineering applies to product design.

Definition

Explanation should include

- the definition of human factors engineering
- the concept of universal design.

Process/Skill Questions

- How can human factors affect the usability of a product?
- What are some examples of poor human factors engineering? What are examples of good human factors engineering?
- How does the Americans with Disabilities Act influence human factors engineering?

ITEEA National Standards

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Engineering Design

Task Number 58

Describe ways consumer products have shaped society and the environment.

Definition

Description should include analysis based on research and data.

Process/Skill Questions

- What effects have products that use electricity had on society and the environment?
- What are some positive and negative effects of the following consumer products?
    - airplane
    - television
    - lawn mower
    - MRI

- virtual reality
- drones
- smartphones

ITEEA National Standards

5. The Effects of Technology on the Environment

7. The Influence of Technology on History

TSA Competitive Events

Essays on Technology

Task Number 59

Select a consumer product to analyze.

Definition

Selection should include identifying a product that

- is composed of more than one material
- is driven by an energy source
- has operational systems and/or subsystems
- is capable of being disassembled.

Process/Skill Questions

- Why did you select this product to analyze?
- How do businesses decide which of their products they want to modify or redesign?
- How do consumers prompt business to modify or redesign a given product?

Task Number 60

Collect product data.

Definition

Collection may include

- technical specifications and drawings
- interpreting charts and graphs
- production numbers
- safety ratings
- data analytics (e.g., sales data)
- government recalls/failures
- performance ratings
- consumer demographics
- product life cycle
- the ethics of the product.

Process/Skill Questions

- What resources are available for retrieving information about consumer products?
- In product analysis, why is it important to research consumer demographics?
- How do new technological advances contribute to the redesign of consumer products? What are some examples?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 61

Reverse engineer a product.

Definition

Reverse engineering should include

- disassembling a product
- documenting steps, parts, and processes using your engineering portfolio, which may include your engineering design journal and sketches, photographs, videos, etc.
- interpreting technical data and images.

Process/Skill Questions

- What is reverse engineering?
- What tools are necessary for reverse engineering?
- What information can be gathered by the reverse-engineering process?
- What cataloging process can be used to maintain the order of parts?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

TSA Competitive Events

Engineering Design

Task Number 62

Analyze how a product works, using mathematical and scientific concepts.

Definition

Analysis may include the following:

- Determining the purpose/use of the product
- Identifying the basic features of the product
- Understanding how the product works using the systems model
- Determining whether a product meets its advertised specifications through testing and documenting results
- Determining whether a product meets other needs
- Determining the underlying mathematical and scientific principles such as volume, area, shape, conversion of energy, conduction, resistance, heat

Process/Skill Questions

- What basic scientific knowledge was necessary for the telephone to be invented?
- What basic mathematical and scientific knowledge was necessary for the computer to be invented?
- What basic mathematical and scientific knowledge was necessary for the development of the automobile engine?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 63

Describe an innovation that would improve a product.

Definition

Description may include

- reviewing the purpose of a product
- reviewing the features of a product, to include functional and aesthetic features
- reviewing the information already collected on the product
- identifying a feature to modify, based on the data.

Process/Skill Questions

- What is the difference between a functional innovation and an aesthetic innovation?
- Why would a company invest in an aesthetic innovation?
- How have recent functional innovations in the manufacturing industry improved the lives of consumers?
- How have recent aesthetic innovations in the automotive industry improved the lives of consumers?

ITEEA National Standards

13. Assess the Impact of Products and Systems

Task Number 64

Draw illustrations of an improved product.

Definition

Drawing may include

- identifying the size and shape of the improvement previously identified
- choosing conventional drawing methods or computer-design software
- drawing a two-dimensional or three-dimensional sketch of the improvement.

Process/Skill Questions

- How is a list of materials and tools required for the modification developed?
- How is a testing procedure to validate a desired outcome developed?
- In what ways might design modification improve the product? How can it be an aesthetic change? A functional change?
- How might an improved product affect the lifestyle of the consumer?
- How might the improved product affect society?

ITEEA National Standards

8. The Attributes of Design

Task Number 65

Construct models of an improved product.

Definition

Construction may include

- determining the most appropriate material for a model (e.g., paper, cardboard, polystyrene foam, wood, clay, commercial modeling system, 3D printing)
- constructing a model
- suggesting how a model could be tested.

Process/Skill Questions

- What is the difference between a model and a prototype?
- What improvements were implemented during the construction process?
- How does consumer input drive modification of product development?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Biotechnology Design

Task Number 66

Represent 3D objects on a two-dimensional surface.

Definition

Representation may include

- using sketching paper or conventional drafting tools
- applying basic concepts of scaling as applied in engineering drawings, blueprints and other two- or three-dimensional representations
- using computer-aided design (CAD) software-making patterns to form 3D objects.

Process/Skill Questions

- What is the difference between an orthographic drawing and a pictorial drawing?
- What is the advantage of viewing an object in three dimensions vs. two dimensions?
- What are the advantages of computer-aided drafting over conventional drafting techniques?
- Why is it important to standardize the way technical drawings and plans are drawn?
- Who retains the rights to a technical drawing—the drafter or the company he or she works for?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Computer-Aided Design (CAD), Engineering

Task Number 67

Create a display or multimedia presentation of an improved product, emphasizing STEM concepts.

Definition

Creation may include

- dimension and scale
- labels
- goals
- data collection
- product analysis
- illustrations
- product improvements.

Process/Skill Questions

- How does audience affect the design of a display?
- What types of mathematical principles are involved in this display (e.g., algebraic formula, statistical data)? What is the importance of each mathematical principle in the design and construction of this improved product?
- In what types of formats can mathematical concepts be displayed (e.g., chart, formula, graph)?
- What types of scientific principles influenced the design change for this product? How did each scientific principle influence the design change?
- In what types of formats can scientific concepts be displayed (e.g., electronic presentation software, animation, technical drawings, sketches)?
- What types of resources could be used in planning the display?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 68

Present recorded information about a product using multimedia.

Definition

Presentation may be accomplished in a variety of ways:

- Graphically (e.g., website, electronic presentation, technical drawing, graph)
- Orally (e.g., electronic multimedia presentations)
- Written (e.g., word-processed documents, spreadsheets, charts, flyers)
- Mathematically or scientifically (e.g., with analysis to prove or reinforce product research)

Process/Skill Questions

- How would one determine the best way(s) to illustrate the product data?
- What are some different types of graphs that may be used to present quantitative data?
- What are the advantages and disadvantages of each type?

ITEEA National Standards

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

Essays on Technology

Prepared Presentation

Using Materials as a Technological Resource

Task Number 69

Classify materials as either natural or synthetic.

Definition

Classification should include the origins and the makeup of the materials.

Process/Skill Questions

- When is wood a natural material? When is it a composite material?
- What are the advantages/disadvantages of synthetic vs. natural materials?
- What are some examples of items that can switch from natural to synthetic by processing?
- What are the differences between natural petroleum oil vs. synthetic oil?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 70

Classify materials according to the major types.

Definition

Classification should include the study of characteristics, application, and optimization of material science for the following types:

- Metals (including alloys)
- Polymers (e.g., wood, plastics, petroleum, fibers)
- Ceramics
- Composites

Process/Skill Questions

- What is the most important characteristic of a ceramic material? Why?
- What is a composite material? How might it be used?
- What are the major types of plastics? How are they similar to each other? How are they different from each other?
- What are the major properties of materials?
- To what degree is each property important in terms of a material's use as a technological resource?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 71

Explain how material resources are processed.

Definition

Explanation should include processing as the act of changing the state or form of a material. Processes to change a material might include the following:

- forming
- separating
- conditioning
- combining
- assembling
- finishing.

Process/Skill Questions

- What is the difference between mechanical and chemical processing?
- How is stainless steel made?
- What items are made of polymers? Why are polymers the chosen material for these products?
- What is the difference between ferrous and nonferrous material?
- What types of products would be composed of ferrous material? Why?
- What types of products would be composed of nonferrous material? Why?
- What are definitions, illustrations, and examples of each of the processes?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 72

Create a detailed diagram for producing a designed product/model/prototype.

Definition

Creation should

- use the engineering design process

- include a detailed flowchart (input, output, feedback, decisions) with measurable milestones.

Process/Skill Questions

- What is the difference between a prototype model and an end product?
- What is the most important factor in the universal systems model?
- Why is a detailed flowchart so important?
- How would one ensure that milestones have been met?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Engineering Design

Task Number 73

Use tools, machines, and processes to change materials to produce a designed product.

Definition

Use should include

- following safety practices
- application of the knowledge, skills, and attitudes for optimization.

Process/Skill Questions

- How is a complex tool, such as a hand drill or hand plane, based on one or more of the six simple machines?
- How would one determine which tools to use for each process?

- How would one use tools/machines to change materials so that they would be more useful in the household (e.g., changing wood into a cutting board, plastic into a napkin holder, metal into a candle holder)?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Process

12. Use and Maintain Technological Products and Systems

Task Number 74

Select the best material for a specific design application.

Definition

Selection should include the following steps:

- Determine the desired application of the material.
- Identify material properties (e.g., hardness, buoyancy, transparency, density, heat resistance, magnetism, melting point, conductivity, thermal expansion, toxicity).
- Test materials (e.g., three types of metal) for their properties.
- Select the material best suited for the application.

Process/Skill Questions

- What are some methods for testing a material for magnetism? For hardness? For conductivity? For density?
- What materials could be used to conduct electricity? In what products would conductivity be an important property?
- What materials could be used to construct the following products: boat, house, sweater? In each case, why would these materials be appropriate for the particular product?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

2. The Core Concepts of Technology

9. Engineering Design

Task Number 75

Predict the outcomes of some technological processes.

Definition

Prediction may be supported by

- flowcharts
- technical drawing
- 3D modeling and other prototyping
- simulation
- mathematical modeling.

Process/Skill Questions

- What are the pros and cons of the processes on materials used?
- What are the processes that can be used?
- How do the processes that are chosen influence the outcome?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

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Task Number 76

Develop a design using recycled materials.

Definition

Development should include the following:

- Determining which types of materials can be recycled
- Defining and giving examples of recycling (e.g., taking waste products, separating them into various types of materials, reclaiming the materials that can be reused)
- Using data to analyze materials and applications

Process/Skill Questions

- What materials are easy to return to a reusable state (e.g., paper, aluminum, plastic)?
- What is the purpose of the recycling code found on plastic containers? Why is it important?
- What products can be made from recycled materials?
- What resources could be conserved by recycling (e.g., trees, materials, electricity, capital)?
- What types of guidelines are available for recycling various types of materials (e.g., plastic, paper, aluminum)?
- Where do materials come from?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

8. The Attributes of Design

9. Engineering Design

Using Energy as a Technological Resource

Task Number 77

Identify the two types of energy.

Definition

Identification should include

- potential energy (stored energy)
- kinetic energy (motion energy).

Process/Skill Questions

- What are examples of potential energy?
- What are examples of kinetic energy?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 78

Analyze forms of energy.

Definition

Analysis should include a definition, illustrations, and examples of use in the following forms:

- electrical
- radiant/light
- thermal/heat
- chemical
- mechanical/fluid
- sound
- nuclear
- gravitational
- elastic.

Process/Skill Questions

- What forms and combinations of energy can be used in technological systems and devices?
- What is an example of a process in which one form of energy is converted into another? How is this conversion achieved (e.g., hydroelectric power, automobile battery, microphone)?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

2. The Core Concepts of Technology

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

TSA Competitive Events

Task Number 79

Identify the sources of energy used with technological devices.

Definition

Identification should include the following sources of energy arranged by their degree of availability:

- Limited/Unsustainable (e.g., coal, oil, natural gas, uranium)
- Unlimited/Sustainable (e.g., solar, wind, gravitational, tidal, geothermal, fusion)
- Renewable (e.g., solar, wind, water, bioenergy, geothermal, wood, biomass gasification, biomass fermentation, animal power, human muscle power)

Process/Skill Questions

- What are two sources of energy for today's automobiles? What are the advantages and disadvantages of each?
- By means of a historical timeline, how would one trace the progression of energy sources used in technological devices since the beginning of technology?
- What current and future types of energy sources could be useful in space travel? How might these energy sources be useful?
- What are examples of limited sources of energy? What are examples of unlimited sources of energy? What are examples of renewable sources of energy?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

Task Number 80

Model the use of energy with mechanical, electrical, fluidic, and thermal systems.

Definition

Modeling may include the following systems:

- Mechanical (e.g., gear train, pulley)
- Electrical (e.g., simple circuit, complex circuit)
- Fluidic (e.g., hydraulic lift, cylinders)
- Thermal (e.g., solar oven, mathematical)

Process/Skill Questions

- How can the use of hydraulic energy when stopping a car be demonstrated?
- How can mechanical energy when propelling a bike be explained?
- How are convection currents used to cook food?
- How is electrical energy used to power a school?

ITEEA National Standards

11. Apply the Design Process

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

Task Number 81

Map the path of current and emerging energy supplies from their source to end-users.

Definition

Mapping should include

- exploring steps necessary to make energy sources readily available (e.g., refining oil, enriching uranium)
- researching the source of the energy
- presenting the results of the research.

Process/Skill Questions

- How can the energy conversion processes in the operation of a smart device be traced?
- What are advances in energy production in your locality?
- What is your school's energy consumption?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

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Task Number 82

Compare methods to conserve energy through technological modification.

Definition

Comparison may consider the following methods:

- Identifying the type of energy to be conserved
- Exploring ways to modify the system to conserve energy
- Identifying techniques used to measure that energy
- Measuring the energy consumed by the technological system
- Calculating the energy saved by the modified system

Process/Skill Questions

- What are common methods of conserving energy in a thermal system? A mechanical system? An electrical system? A fluidic system?
- What are some reasons that conservation of nonrenewable energy is important?
- Is conservation of unlimited energy ever important? Why or why not?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

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Controlling an Electronic System

Task Number 83

Analyze a problem whose solution uses electronic controls.

Definition

Analysis should

- determine the problem to be solved
- include a definition of control (the limitation of the inputs, process, and/or outputs of a system)
- determine possible electronically controlled solutions.

Process/Skill Questions

- How would you create a system that electronically controls vehicular motion? A system that electronically transports supplies or materials from one point to another? A system that activates a warning sound?
- In what products or situations might computer control be an advantage? A disadvantage?
- How have computer controls enhanced your daily life?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Process

9. Engineering Design

Task Number 84

Describe the different methods for using electronically controlled devices.

Definition

Description should include identifying

- what control system(s) are available (e.g., thermostats, sensors, AI, programmable logic controllers)
- human interface (e.g., keypads, voice-activated devices, mobile apps).

Process/Skill Questions

- What resources can be used to obtain information on different electronically controlled systems?
- How can it be determined that the resource is valid?
- What is the human interface in this electronically controlled device?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Process

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

Task Number 85

Use engineering design to solve an identified problem using an electronically controlled device .

Definition

Use may include

- identifying methods of control by computer (e.g., programming) or electronics (e.g., circuits)
- organizing the process for solving the problem
- creating a diagram or schematic
- refining the diagram or schematic into a working drawing, using computer-design software
- choosing materials for the design
- using applicable science and mathematics to analyze the design
- creating a bill of materials
- creating a model.

Process/Skill Questions

- What is the difference between a computer-controlled system and an electronically controlled system?
- What are examples of products that are electronically controlled but not computer controlled?
- What would be some considerations for selecting the most practical method of computer (or electronic) control?
- What scientific and mathematical principles are used to analyze the design?
- What electronics/computer knowledge is likely necessary to arrive at the solution to the problem?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

11. Apply the Design Process

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

9. Engineering Design

TSA Competitive Events

Engineering Design

Task Number 86

Construct a functional model of an electronically controlled device.

Definition

Construction should include the use of an engineering design process and a commercial modeling system or other materials.

Process/Skill Questions

- When using an electronically controlled device, what are the safety considerations to consider when constructing a model?
- Why are electronically controlled devices valuable in society?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Engineering Design

Task Number 87

Control a device with a microcontroller.

Definition

Control may include the following:

- Installing software or building an interface
- Writing a control program
- Testing the functionality of the application
- Making adjustments to the components
- Debugging the program
- Retesting for functionality

Process/Skill Questions

- What types of computer programming languages are commonly used for programming a controller?
- How would you choose the most appropriate language for a particular control application?
- What is the difference between autonomous and human control of an electronic device?
- What types of problems need to be solved in the system?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

TSA Competitive Events

Software Development

Task Number 88

Present information about an electronically controlled device.

Definition

Presentation should include

- stating the problem to be solved
- summarizing relevant research
- describing the design of the solution
- outlining the process for constructing the application
- demonstrating the functionality of the control device(s)
- reflection (i.e., lessons learned).

Process/Skill Questions

- What methods could be used to present the information?
- How would one go about summarizing relevant research for a report to an audience? What graphics may be useful?

ITEEA National Standards

9. Engineering Design

Designing a Product

Task Number 89

Evaluate the needs and wants of people in school, home, community, or world that could be met through technological change.

Definition

Evaluation may include

- inexpensive fuel sources
- plentiful food supply
- a clean environment
- safe and affordable housing
- a comfortable living environment
- adequate and clean water supply
- adequate medical care
- diverse abilities (e.g., physical or cognitive challenges)
- a natural disaster warning system.

Process/Skill Questions

- What is the difference between a need and a want?
- How might needs and wants differ from one geographical area to another?
- What types of human problems has technology already solved?
- How are problems prioritized?
- What types of problems could potentially arise in our world?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

4. The Cultural, Social, Economic, and Political Effects of Technology

TSA Competitive Events

Biotechnology Design

Task Number 90

Write a statement that defines a problem, challenge, need, or opportunity.

Definition

A written problem statement should include

- a goal
- a concise statement that clearly defines the problem
- identification of constraints and criteria.

Process/Skill Questions

- Why is it important to state a technological problem before trying to solve it?
- What is an example of a goal?
- What are examples of constraints and criteria of a problem?

ITEEA National Standards

9. Engineering Design

Task Number 91

Collect information about a technological problem to be solved.

Definition

Collection of information may include

- identifying acceptable standards for information sources
- scientifically valid research about the problem
- recording information
- identifying technologies or products that may be modified to meet the identified requirements.

Process/Skill Questions

- How are valid sources identified?
- What is the process for determining the scope of a problem?

- What resources can provide information about community problems? About global problems?
- How can information about school problems be researched? About home problems?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

9. Engineering Design

TSA Competitive Events

Technology Problem Solving

Task Number 92

Generate potential solutions to the problem, challenge, need, or opportunity.

Definition

Generation should include

- brainstorming
- research to explore possible solutions
- sketches, graphics, and notes validation based on mathematical analysis and data.

Process/Skill Questions

- How might sketches and graphics be used to depict alternative solutions?
- Why is it important to explore more than one solution to a problem?
- What other methods could be used to find alternative solutions (e.g., brainstorming, interviews, polling)?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Biotechnology Design

Engineering Design

Task Number 93

Select the best solution for a problem.

Definition

Selection should include

- a decision matrix
- constraints
- criteria
- trade-offs
- optimization
- sketches.

Process/Skill Questions

- What is a decision matrix, and how is it created?
- Why must trade-offs and optimizations be included?
- How can sketches help in selecting the best solution?

ITEEA National Standards

9. Engineering Design

Task Number 94

Construct a prototype of the best solution.

Definition

Construction may include

- creating a working drawing
- developing a fabrication process with measurable steps in the process
- creating a bill of materials
- incorporating computer and power systems
- developing a process to complete the production.

Process/Skill Questions

- What are the safety considerations for constructing the model?
- What is the purpose of a prototype?
- How does one determine the logical sequence involved in building a prototype?
- Why is a working drawing important before starting work on the prototype?

ITEEA National Standards

11. Apply the Design Process

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

Task Number 95

Evaluate the solution by comparing it with the problem statement, constraints, and criteria.

Definition

Evaluation should include

- reviewing the problem statement
- describing the trade-offs of the solution
- testing the solution to determine the extent to which the solution solves the problem
- comparing mathematical analysis data
- revising the existing solution.

Process/Skill Questions

- Why is important to evaluate the solution against the problem statement?
- What types of tests should be performed to test the solution?

- How does the solution satisfy the original wants and needs of people in school, home, community, or world?
- Why is it important to revise the solution?

ITEEA National Standards

13. Assess the Impact of Products and Systems

9. Engineering Design

Task Number 96

Present the final product.

Definition

Presentation should include

- explaining the technological problem solved by the model
- identifying the process used for selecting the best solution among alternatives
- citing relevant resources used to research the solution
- explaining the design for the selected solution
- demonstrating the prototype
- highlighting the benefits and trade-offs of the prototype
- soliciting questions and suggested improvements from the audience
- validating selection with data.

Process/Skill Questions

- Why is it important to solicit suggestions from the audience?
- What methods may be used to capture and maintain the audience's interest?
- Why is it important to present the prototype to a targeted audience before beginning mass production?

ITEEA National Standards

13. Assess the Impact of Products and Systems

9. Engineering Design

TSA Competitive Events

SOL Correlation by Task

39	Define technology.	English: 9.4, 10.4, 11.3 History and Social Science: VUS.1, VUS.2, VUS.3, VUS.4, VUS.5, VUS.6, VUS.7, VUS.8, VUS.9, VUS.10, VUS.11, VUS.12, VUS.13, VUS.14, WG.1, WG.4, WG.16, WG.17, WHI.1, WHI.2, WHI.3, WHI.4, WHI.5, WHI.6, WHI.9, WHI.10, WHI.11, WHI.12, WHI.13, WHI.14, WHI.15, WHII.1, WHII.2, WHII.3, WHII.4, WHII.5, WHII.6, WHII.7, WHII.8, WHII.9, WHII.10, WHII.11, WHII.12, WHII.13, WHII.14
40	Explain the characteristics and scope of technology.	English: 9.4, 10.4, 11.3, 11.5 History and Social Science: VUS.8, WHII.8
41	Identify the core concepts of technology.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WG.4, WG.16, WHII.8
42	Describe the basic systems model.	English: 9.4, 10.4, 11.5
43	Distinguish between an open- and closed-loop system.	English: 9.4, 10.4, 11.3, 11.5
44	Explain how systems may have varying outputs.	English: 9.4, 10.4, 11.5 Mathematics: COM.10
45	List technological resources and their function in a system.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7 History and Social Science: VUS.8, WG.4, WHI.2, WHII.8 Mathematics: COM.2, COM.10, COM.11
46	Explain what process does in a system.	English: 9.4, 10.4, 11.5
47	Identify the seven resources for a particular technological system.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WG.4, WHII.8

48	Describe an engineering design process that is used to design a product.	English: 9.4, 10.4, 11.3, 11.5 History and Social Science: VUS.8, WHII.8 Mathematics: COM.1, COM.2, COM.10, COM.11, COM.17, COM.18 Science: BIO.1, PH.1
49	Identify common technological processes that convert materials or energy to produce an output or solution.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.2, VUS.3, VUS.4, VUS.6, VUS.7, VUS.8, VUS.9, VUS.10, VUS.11, VUS.12, VUS.13, VUS.14, WG.4, WHI.2, WHI.3, WHI.4, WHI.5, WHI.6, WHI.10, WHI.11, WHI.12, WHI.13, WHI.14, WHII.4, WHII.5, WHII.6, WHII.7, WHII.8, WHII.10, WHII.11, WHII.12
50	Describe the core areas of STEM.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WHII.4, WHII.8 Science: PH.3
51	Use the Pythagorean theorem during a problem-solving activity	History and Social Science: WHI.5 Mathematics: G.8
52	Identify career opportunities in a variety of technological contexts.	English: 9.4, 10.4, 11.5 History and Social Science: GOVT.8, GOVT.15
53	Illustrate the concept of a technological system.	
54	Distinguish between a system and a subsystem.	English: 9.4, 10.4, 11.5 Mathematics: COM.5
55	Analyze the effects of technological systems on society and the environment.	English: 9.4, 10.4, 11.5 History and Social Science: GOVT.1, WG.1, WHI.1, WHII.1
56	Define consumer.	English: 9.4, 10.4, 11.3 History and Social Science: GOVT.14, GOVT.15
57	Explain how human factors engineering applies to product design.	English: 9.4, 10.4, 11.5

58	Describe ways consumer products have shaped society and the environment.	English: 9.4, 10.4, 11.5 History and Social Science: WG.4, WG.14, WG.16
59	Select a consumer product to analyze.	English: 9.4, 10.4, 11.5
60	Collect product data.	English: 9.4, 10.4, 11.5 History and Social Science: GOVT.14, GOVT.15 Mathematics: AFDA.8, PS.1*, PS.2*, PS.3*, PS.4*, PS.8*, PS.9*, PS.10*
61	Reverse engineer a product.	English: 9.4, 9.6, 9.7, 10.4, 10.6, 10.7, 11.5, 11.6, 11.7
62	Analyze how a product works, using mathematical and scientific concepts.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WHII.6, WHII.8 Mathematics: G.13, G.14 Science: PH.4
63	Describe an innovation that would improve a product.	English: 9.4, 10.4, 11.5
64	Draw illustrations of an improved product.	English: 9.4, 10.4, 11.5 Mathematics: G.3, G.8, G.9, G.11, G.13, G.14
65	Construct models of an improved product.	
66	Represent 3D objects on a two-dimensional surface.	English: 9.4, 10.4, 11.5 Mathematics: G.3, G.13, G.14
67	Create a display or multimedia presentation of an improved product, emphasizing STEM concepts.	English: 9.2, 9.4, 9.6, 9.7, 10.4, 10.6, 10.7, 11.1, 11.5, 11.6, 11.7 Mathematics: G.3, G.13, G.14, AFDA.8, COM.7, COM.9, COM.15, PS.1*, PS.2*, PS.3*, PS.4*, PS.7*, PS.8*, PS.9*, PS.10*, PS.11*
68	Present recorded information about a product using multimedia.	English: 9.4, 9.6, 9.7, 10.4, 10.6, 10.7, 11.5, 11.6, 11.7 Mathematics: A.7, A.8, A.9, AFDA.2, AFDA.3, AFDA.8, AII.6, AII.7, AII.9, COM.10, COM.11, PS.1*, PS.2*, PS.3*, PS.4*, PS.7*
69	Classify materials as either natural or synthetic.	English: 9.4, 10.4, 11.5

		History and Social Science: VUS.8, WHII.8
70	Classify materials according to the major types.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WHII.8
71	Explain how material resources are processed.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WHII.8
72	Create a detailed diagram for producing a designed product/model/prototype.	English: 9.4, 10.4, 11.5
73	Use tools, machines, and processes to change materials to produce a designed product.	History and Social Science: VUS.8, WHII.8
74	Select the best material for a specific design application.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WHII.8
75	Predict the outcomes of some technological processes.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.8, WHII.8 Mathematics: A.4, A.5, A.7, AFDA.1, AFDA.2, AFDA.3, AFDA.4, AII.6, AII.7, AII.9
76	Develop a design using recycled materials.	English: 9.4, 10.4, 11.3, 11.5 History and Social Science: WG.4 Mathematics: AFDA.8, PS.1*, PS.2*, PS.3*, PS.4*, PS.7*, PS.8*, PS.9*, PS.10*
77	Identify the two types of energy.	English: 9.4, 10.4, 11.5 Science: PH.6
78	Analyze forms of energy.	English: 9.4, 10.4, 11.3, 11.5 History and Social Science: VUS.8, VUS.11, WHII.8, WHII.11 Science: PH.6
79	Identify the sources of energy used with technological devices.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.14, WG.4, WG.17, WHII.14 Science: ES.6
80	Model the use of energy with mechanical, electrical, fluidic, and thermal systems.	English: 9.4, 10.4, 11.5

		History and Social Science: VUS.8, WHII.8 Science: PH.10, PH.11, PH.12
81	Map the path of current and emerging energy supplies from their source to end-users.	English: 9.4, 9.8, 10.4, 10.8, 11.5, 11.8 History and Social Science: VUS.14, WG.16, WG.17, WHII.14
82	Compare methods to conserve energy through technological modification.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.14, WG.17, WHII.14
83	Analyze a problem whose solution uses electronic controls.	English: 9.4, 10.4, 11.5
84	Describe the different methods for using electronically controlled devices.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.14, WG.17, WHII.14
85	Use engineering design to solve an identified problem using an electronically controlled device .	English: 9.4, 10.4, 11.5 Mathematics: A.4, A.5, A.6, A.7, G.13, G.14, AFDA.1, AFDA.2, AFDA.3, AFDA.4, AII.2, AII.7, AII.9
86	Construct a functional model of an electronically controlled device.	
87	Control a device with a microcontroller.	English: 9.4, 9.6, 9.7, 10.4, 10.6, 10.7, 11.5, 11.6, 11.7 Mathematics: COM.1, COM.2, COM.5, COM.8, COM.10, COM.11, COM.17, COM.18
88	Present information about an electronically controlled device.	English: 9.2, 9.4, 9.6, 9.7, 10.2, 10.4, 10.6, 10.7, 11.1, 11.5, 11.6, 11.7
89	Evaluate the needs and wants of people in school, home, community, or world that could be met through technological change.	English: 9.4, 10.4, 11.5 History and Social Science: VUS.14, WG.17, WHII.14
90	Write a statement that defines a problem, challenge, need, or opportunity.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7 Mathematics: COM.3
91	Collect information about a technological problem to be solved.	English: 9.4, 10.4, 11.5
92	Generate potential solutions to the problem, challenge, need, or opportunity.	English: 9.4, 9.8, 10.4, 10.8, 11.5, 11.8
93	Select the best solution for a problem.	English: 9.4, 10.4, 11.5

94	Construct a prototype of the best solution.	English: 9.2, 9.4, 9.6, 9.7, 10.2, 10.4, 10.6, 10.7, 11.2, 11.5, 11.6, 11.7
95	Evaluate the solution by comparing it with the problem statement, constraints, and criteria.	English: 9.4, 10.4, 11.5 Mathematics: PS.1*, PS.2*, PS.20, PS.3*, PS.4*
96	Present the final product.	English: 9.4, 10.4, 11.5 Mathematics: PS.1*, PS.2*, PS.20, PS.3*, PS.4*

TSA (Technology Student Association) Competitive Events Correlation by Duty Area

Duty/Concept Area: Exploring Technology Foundations

1. Engineering Design
2. Career Preparation
3. Manufacturing Prototype
4. System Control Technology
5. Dragster Design

Duty/Concept Area: Understanding Technological Systems

1. Engineering Design
2. Debating Technological Issues
3. Systems Control Technology

Duty/Concept Area: Analyzing Consumer Products

1. Manufacturing Prototype
2. Engineering Design

Duty/Concept Area: Using Materials as a Technological Resource

1. Engineering Design
2. Manufacturing Prototype
3. Structural Engineering
4. Biotechnology Design

Duty/Concept Area: Using Energy as a Technological Resource

1. Computer Numerical Control Production
2. Dragster

Design Duty/Concept Area: Designing and Building a System Controlled by Electronics

1. Animatronics
2. System Control Technology

Duty/Concept Area: Designing a New or Improved Product to Solve a Problem

1. Engineering Design
2. Manufacturing Prototype
3. Biotechnology Design

Cyber Security and Cyber Forensics Infusion Units

Cyber Security and Cyber Forensics Infusion Units (CYBR) were designed to be infused with designated CTE courses to help students in those programs achieve additional, focused, validated tasks/competencies in personal and professional cyber security skills. These units are not mandatory, and, as such, the tasks/competencies are marked as "optional," to be taught at the instructor's discretion.

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- National Career Readiness Certificate Assessment
- Stratasys Additive Manufacturing Certification – Level 1 Examination
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Technical Drawing and Design (8434/18 weeks)
- Technical Drawing and Design (8435/36 weeks)
- Technology Assessment (8406/18 weeks)
- Technology Assessment (8407/36 weeks)
- Technology Transfer (8404/18 weeks)
- Technology Transfer (8405/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	**Occupations**
Environmental Service Systems	**Environmental Sampling and Analysis Technician** **Hazardous Materials Handler** **Recycling Coordinator** **Water Conservationist**
Natural Resources Systems	**Ecologist** **Forest Manager, Forester** **Forest Technician** **Wildlife Manager**
Plant Systems	**Crop Grower** **Plant Breeder/ Geneticist** **Soil and Plant Scientist**

Career Cluster: Architecture and Construction	
Pathway	**Occupations**
Design/Pre-Construction	**Architect** **Civil Engineer** **Cost Estimator** **Landscape Architect**

Career Cluster: Arts, Audio/Video Technology and Communications	
Pathway	**Occupations**
Audio and Video Technology and Film	**Editor** **Producer** **Sound Engineering Technician**
Journalism and Broadcasting	**Art Director** **Editor** **Program Director** **Radio, TV Announcer** **Radio, TV Reporter**
Printing Technology	**Production, Planning, Expediting Clerk**
Telecommunications	**Computer Programmer** **Network Systems and Data Communication Analyst**

Career Cluster: Business Management and Administration	
Pathway	**Occupations**
Business Information Management	**Chief Executive Officer** **Cost Analyst** **Financial Analyst** **Market Research Analyst** **Operations Research Analyst** **Systems Analyst**
General Management	**Chief Executive Officer** **Entrepreneur**

Career Cluster: Finance	
Pathway	**Occupations**
Business Finance	**Cost Analyst** **Economist**
Securities and Investments	**Real Estate Developer**

Career Cluster: Government and Public Administration	
Pathway	**Occupations**
Governance	**Legislator**

Career Cluster: Government and Public Administration	
Pathway	**Occupations**
Planning	**Economic Development Coordinator** **Urban and Regional Planner**
Regulation	**Compliance Officer** **Environmental Compliance Inspector**

Career Cluster: Health Science	
Pathway	**Occupations**
Biotechnology Research and Development	**Biochemist** **Research Assistant**

Career Cluster: Manufacturing	
Pathway	**Occupations**
Health, Safety, and Environmental Assurance	**Safety Engineer**
Manufacturing Production Process Development	**Industrial Engineer** **Industrial Engineering Technician**

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Engineering and Technology	**Agricultural Engineer** **Biomedical Engineer** **Civil Engineer** **Civil Engineering Technician** **Environmental Engineer** **Industrial Engineer** **Industrial Engineering Technician** **Materials Engineer** **Nuclear Engineer** **Power Systems Engineer**
Science and Mathematics	**Atmospheric Scientist** **Ecologist** **Economist** **Environmental Scientist** **Geoscientist** **Hydrologist** **Oceanographer** **Research Chemist** **Technical Writer**

Career Cluster: Transportation, Distribution and Logistics	
Pathway	**Occupations**
Facility and Mobile Equipment Maintenance	**Aircraft Structure, Surfaces, Rigging, and Systems Assembler**
Health, Safety and Environmental Management	**Health, Safety, and Environment Manager**
Logistics Planning and Management Services	**Logistics Analyst** **Logistics Engineer** **Logistics Manager**
Transportation Operations	**Air Traffic Controller** **Flight Engineer** **Pilot** **Ship Engineer** **Transportation Manager**
Transportation Systems/Infrastructure Planning, Management and Regulation	**Aerospace Engineer** **Civil Engineer** **Civil Engineering Technician** **Pilot** **Traffic Engineer** **Transportation Manager** **Urban, Regional Planner**
Warehousing and Distribution Center Operations	**Traffic Engineer** **Transportation Manager**