

Technology Education- Development

8471 36 weeks

Table of Contents

Acknowledgments.....	1
Course Description.....	2
Task Essentials Table.....	2
Curriculum Framework.....	5
Understanding Technology and Society	5
Understanding the Nature of Technology	17
Planning a Technological Solution	24
Producing a Technological Solution.....	39
Evaluating a Technological Solution.....	44
SOL Correlation by Task	49
Entrepreneurship Infusion Units	53
Appendix: Credentials	53

Acknowledgments

The following educators served on the Curriculum Development team:

George Bishop, Battlefield High School, Prince William County Public Schools
Emily Loving, Instructional Specialist for Science K-12, Chesterfield County Public Schools
Olimpia Stein, Surry County High School, Surry County Public Schools
LaTasha M. Watson, Highland Springs High School, Henrico County Public Schools
B. Ray Wu-Rorrer, Mary Ellen Henderson Middle School, Falls Church City Public Schools

The framework was edited and produced by the CTE Resource Center:

Kevin P. Reilly, Administrative Coordinator
Taylor B. Mooney, Writer/Editor

Lynn Basham, Specialist, Technology Education and Related Clusters
Office of Career and Technical Education Services
Virginia Department of Education

B. Anne Rowe, CTE Career Cluster Coordinator
Office of Career and Technical Education Services
Virginia Department of Education

Lolita B. Hall, Director
Office of Career and Technical Education Services
Virginia Department of Education

Copyright © 2015

Course Description

Suggested Grade Level: 9 or 10 or 11 or 12

This course is designed to enable students to explore technology/society interactions and to apply science, technology, and mathematics concepts to solve problems and innovate designs, while in a laboratory setting. Students are given the opportunity to link the study of technology to various jobs/careers.

Note: The career cluster will be determined by other courses taken in conjunction with this course to develop a concentration sequence.

Note: The class size shall be limited to an average of 10 students per instructor per class period with no class being more than 12 or up to an average of 12 students per class period with no class being more than 15 where an instructional aide is provided.

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	8471	Tasks/Competencies
Understanding Technology and Society		
39	⊕	Define <i>technology</i> .
40	⊕	Identify the importance of technology in everyday life.
41	⊕	Describe the importance of technology in the development of society and the environment.
42	⊕	List examples of emerging technologies.
43	⊕	Predict technological changes.
44	○	Describe ways society influences the creation of certain technologies.
45	○	Assess the impact of technology on individuals, resources, society, and the environment.
46	⊕	Explore career opportunities to determine occupational and educational choices.
47	⊕	Present information regarding technological solutions to human problems, using various technologies.
Understanding the Nature of Technology		
48	⊕	Identify the core concepts of technology.
49	⊕	Analyze a basic technological system.
50	⊕	Analyze technological resources.
51	⊕	Compare sources of energy, types of sustainable energies, and energy converters.
52	⊕	Describe how tool and machine resources provide various processes.
53	⊕	Illustrate the ways processes change input resources into outputs in a manufacturing system.
54	⊕	Describe ways that people control technology.
Planning a Technological Solution		

55	<input checked="" type="radio"/>	Apply safety procedures and practices.	
56	<input checked="" type="radio"/>	Explain the engineering design process.	
57	<input checked="" type="radio"/>	Describe how specifications and constraints affect the design process.	
58	<input checked="" type="radio"/>	Describe how trade-offs may be made during the design process in order to optimize a solution.	
59	<input checked="" type="radio"/>	Demonstrate linear measurement techniques.	
60	<input checked="" type="radio"/>	Convey three-dimensional objects on a two-dimensional surface, using conventional and/or computer technology.	
61	<input checked="" type="radio"/>	Describe the characteristics and/or properties of materials.	
62	<input checked="" type="radio"/>	Propose a solution to an assigned technological problem by applying processes and resources.	
63	<input checked="" type="radio"/>	Formulate a problem statement for the assigned technological problem to be solved.	
64	<input checked="" type="radio"/>	Design a product or system to solve the problem statement for the assignment.	
65	<input checked="" type="radio"/>	Construct a working prototype of the assigned design problem.	
66	<input checked="" type="radio"/>	Evaluate the prototype through testing.	
Producing a Technological Solution			
67	<input type="radio"/>	Design a technological solution for a problem as part of a team.	
68	<input type="radio"/>	Select technologies and resources to solve a problem as a team.	
69	<input type="radio"/>	Refine the solution, using problem-solving and teamwork skills.	
70	<input type="radio"/>	Produce the result of the design process.	
Evaluating a Technological Solution			
71	<input checked="" type="radio"/>	Evaluate the solution by comparing it with the problem statement.	
72	<input type="radio"/>	Assess the impact of the product on individuals, resources, society, and the environment.	
73	<input type="radio"/>	Produce a technical report as part of a team.	

74	<input type="radio"/>	Present a final project report as part of a team.
----	-----------------------	---

Legend: Essential Non-essential Omitted

Curriculum Framework

Understanding Technology and Society

Task Number 39

Define *technology*.

Definition

Definition should include the following:

- Technology is applied knowledge, creativity, and resources to meet human needs and wants, to solve problems, and to extend human potential.
- Technology consists of the man-made world, products, systems, and processes.
- Technology uses resources such as tools, materials, people, capital, time, energy, and information.

Process/Skill Questions

- What is technology?
- Why is the study of technology important?
- How does technology impact your life?
- What is the relationship between the "designed" world and the "natural" world?

ITEEA National Standards

1. The Characteristics and Scope of Technology

2. The Core Concepts of Technology

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

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 40

Identify the importance of technology in everyday life.

Definition

Identification should include:

- Technology is everywhere (ubiquitous).
- Technology affects basic human wants and needs.
- Technology solves problems.
- Technology increases productivity/efficiency.
- Technology improves quality of life.

Process/Skill Questions

- What are the basic human needs?
- What are some examples of technology?
- How has technology evolved?

Common Career Technical Core

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

1. The Characteristics and Scope of Technology

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 41

Describe the importance of technology in the development of society and the environment.

Definition

Description should include the following:

- Technology fuels sustainable economic expansion and enables global competitiveness.
- Inventions and innovations improve quality of life.
- Advances in technology are vital to promote personal safety and to protect society (e.g., through the military).
- Energy innovations are key to meeting potential needs and protecting our environment.
- Technology enhances learning.

Process/Skill Questions

- How do human needs and wants affect technology?
- What are some examples of technology in each of the major areas of the designed world?
- What are some negative effects of technology on society or the environment?
- How does technology impact or create changes in society?
- What are some inventions or technology innovations that have changed the world?

Common Career Technical Core

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

1. The Characteristics and Scope of Technology

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 42

List examples of emerging technologies.

Definition

List should include developments in transportation, medicine, entertainment, manufacturing, construction, and agriculture.

Process/Skill Questions

- What resources are available to help us learn about emerging technologies?
- What are the emerging technologies of this century?
- What is hypersonic flight?
- How can implant chips be used in medical technology?
- How have technological advances impacted our ability to explore space and sustain life on other planets?
- What makes an emerging technology successful?

Common Career Technical Core

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

1. The Characteristics and Scope of Technology

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

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

17. Information and Communication Technologies

18. Transportation Technologies

19. Manufacturing Technologies

2. The Core Concepts of Technology

20. Construction Technologies

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 43

Predict technological changes.

Definition

Predictions should be based on comparison of current and past data and information.

Process/Skill Questions

- What is a trend?
- How does society influence future technologies?
- How might technology influence future societies?

Common Career Technical Core

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

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

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

9. Engineering Design

TSA Competitive Events

Engineering Design

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 44

Describe ways society influences the creation of certain technologies.

Definition

Description should include examples of technologies that have been created because of the demands of society and/or the environment.

Process/Skill Questions

- How is society dependent on technology?
- How does society adapt to new technologies?
- How does society limit or expand the use of technologies?
- What ethical issues relate to the selection and use of technology?

Common Career Technical Core

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

1. The Characteristics and Scope of Technology

13. Assess the Impact of Products and Systems

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

17. Information and Communication Technologies

18. Transportation Technologies

19. Manufacturing Technologies

2. The Core Concepts of Technology

20. Construction Technologies

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 45

Assess the impact of technology on individuals, resources, society, and the environment.

Definition

Assessment of the impact of technology may be achieved through research or survey and should include documentation of the positive and negative impacts.

Process/Skill Questions

- What are some positive and negative consequences of a technology?
- What are expected and unexpected impacts of a technology?
- How can an impact of a technology be planned and still be undesirable?
- What are examples of anticipated and unanticipated impacts that a particular technology has had on society?
- What are some positive effects of technology on society and/or the environment? Of society on technology?
- What are some negative effects of technology on society and/or the environment? Of society on technology?

Common Career Technical Core

ST3

Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

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

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

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

5. The Effects of Technology on the Environment

7. The Influence of Technology on History

9. Engineering Design

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 46

Explore career opportunities to determine occupational and educational choices.

Definition

Exploration should include identifying and investigating careers and opportunities for gaining experience related to the following areas of the designed world (*ITEEA Standards for Technological Literacy*):

- Energy and power
- Transportation
- Information and communication
- Manufacturing
- Construction
- Medical
- Agriculture and biotechnology

Many websites offer career exploration resources, including the Bureau of Labor Statistics' [Occupational Outlook Handbook](#).

Process/Skill Questions

- What are some career opportunities in each of the areas of the designed world?
- What are some resources for information on careers in Virginia and nationwide?
- What are the tasks, knowledge, skills, and abilities required for some occupations related to the technology areas mentioned above?

Common Career Technical Core

ST5

Demonstrate an understanding of the breadth of career opportunities and means to those opportunities in each of the Science, Technology, Engineering & Mathematics Career Pathways.

ITEEA National Standards

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

Task Number 47

Present information regarding technological solutions to human problems, using various technologies.

Definition

Presentation should communicate ideas quickly and effectively by using traditional methods (e.g., a safety poster) or by means of computer software that allows the presenter to combine text, graphics, sound, video or animation, and other imaging effects.

Process/Skill Questions

- How do you determine the most appropriate technology for presenting graphics, text, or data in a certain situation?
- How do you choose the most effective or most appropriate media for the message?
- What types of software are available for combining text and graphics to create a presentation?

Common Career Technical Core

ST-ET2

Display and communicate STEM information.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST-ET6

Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.

ST2

Use technology to acquire, manipulate, analyze and report data.

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

17. Information and Communication Technologies

2. The Core Concepts of Technology

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

TSA Competitive Events

Biotechnology Design

Essays on Technology

Prepared Presentation

Understanding the Nature of Technology

Task Number 48

Identify the core concepts of technology.

Definition

Identification should include systems, resources, requirements, trade-offs, processes, and controls.

Process/Skill Questions

- How are systems important to technology?
- What are the resources required for any technological system?
- How do specifications and limitations affect a technological system?
- How are resources changed into useful products?
- What are some ways to control technological systems?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 49

Analyze a basic technological system.

Definition

Analysis should include that systems are parts working together for a common goal. Systems have input, processes, output, and feedback, with resources identified in the system.

Process/Skill Questions

- Why might we analyze a technological system?
- How do resources work with processes in a system?
- What part does feedback play in a system?

ITEEA National Standards

2. The Core Concepts of Technology

TSA Competitive Events

Engineering Design

Essays on Technology

Extemporaneous Speech

Prepared Presentation

System Control Technology

Task Number 50

Analyze technological resources.

Definition

Analysis should include tools, information, materials, people, time, energy, and capital, and how each contributes to a system.

Process/Skill Questions

- What items can be considered tools or machines?
- How does information act as a resource for technology?
- How do people act as resources for technology?
- How are the resources of time and capital (i.e., money) important when making decisions about technology?

Common Career Technical Core

ST-ET3

Apply processes and concepts for the use of technological tools in STEM.

TSA Competitive Events

Engineering Design

Essays on Technology

Extemporaneous Speech

Prepared Presentation

System Control Technology

Task Number 51

Compare sources of energy, types of sustainable energies, and energy converters.

Definition

Comparison should be made among the following common energy sources and should address their sustainability:

- Biological
- Chemical
- Mechanical
- Solar
- Hydraulic

Comparison should be made among the following common energy converters (change one type of energy into a different energy form):

- Mechanical
- Thermal
- Chemical
- Solar
- Fluid

Process/Skill Questions

- What is energy?
- Why is energy converted?
- What are some different ways that energy can be converted?
- What are some different forms of energy before and after conversion?
- What are some forms of sustainable energy?

Common Career Technical Core

ST3

Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

18. Transportation Technologies

19. Manufacturing Technologies

20. Construction Technologies

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Biotechnology Design

Essays on Technology

Extemporaneous Speech

Prepared Presentation

Task Number 52

Describe how tool and machine resources provide various processes.

Definition

Description should include forming, separating, and combining materials and identifying which tools or machines will accomplish the processes.

Process/Skill Questions

- Which hand tools and machines can be used for separating materials?
- What are some tools around the home that can be used for separating materials?
- What are examples of tools or machines forming material?
- What process is used with a 3-D printer?
- What is the difference between additive and subtractive manufacturing processes?

Common Career Technical Core

ST-ET3

Apply processes and concepts for the use of technological tools in STEM.

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Biotechnology Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

Transportation Modeling

Task Number 53

Illustrate the ways processes change input resources into outputs in a manufacturing system.

Definition

Illustration should demonstrate how processes change input resources to outputs by separating, adding, forming, or changing the internal structure of the materials.

Process/Skill Questions

- What is an input? An output?
- What are the types of processes used in technological systems?
- What are some materials that can be altered?
- How can altering or changing material solve a problem?
- How is a closed-loop system different from an open-loop system?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

17. Information and Communication Technologies

18. Transportation Technologies

19. Manufacturing Technologies

2. The Core Concepts of Technology

20. Construction Technologies

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

Task Number 54

Describe ways that people control technology.

Definition

Description should include the choice to use the technology, the use of energy for technology, and the identification of what causes the technology to do what it should.

Process/Skill Questions

- What are some ways we control communication technology?
- How is transportation technology controlled?
- What kinds of controls does manufacturing technology have?
- What kinds of controls does agricultural technology have?

Common Career Technical Core

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

Planning a Technological Solution

Task Number 55

Apply safety procedures and practices.

Definition

Application of safety procedures and practices in the classroom should include an understanding of all safety-related signage, instructions, safety data sheets (SDSs), manuals, and rules.

Potential dangers in the technology classroom may include the following:

- Thermal and chemical burns
- Falls
- Sharp objects
- Moving parts
- Electrical hazards

Corresponding safety procedures/practices that students should apply include the following:

- Wearing safety glasses, gloves, aprons, and other types of protective clothing
- Cleaning debris and spills
- Avoiding horseplay

- Handling and storing supplies and equipment safely
- Avoiding loose clothing, tying back long hair, removing jewelry
- Getting permission from the teacher to use tools and machines

Process/Skill Questions

- Why is it important to take your time when performing a procedure?
- What precautions should be taken to avoid chemical burns? Eye injuries?
- In the business world, what are the daily costs of lost employee time due to injuries?
- How would you analyze your technology lab for safety hazards and violations?
- How might the hazards or violations be eliminated?
- What does OSHA stand for? What is its significance?

Common Career Technical Core

ST3

Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

ITEEA National Standards

11. Apply the Design Process

9. Engineering Design

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

Transportation Modeling

Task Number 56

Explain the engineering design process.

Definition

Explanation should include the following process steps:

- Identify the need, goal, and constraints.
- Research the problem.
- Develop possible solutions.
- Select a promising solution based on optimization.
- Build a prototype.
- Test and evaluate the prototype.
- Redesign as needed.

Engineering design techniques may include

- brainstorming
- common-sense reasoning
- creative problem solving
- deductive reasoning
- inductive reasoning
- innovation
- inquiry
- trial and error
- troubleshooting.

Process/Skill Questions

- What are the steps involved in engineering design?
- How is a solution to a problem evaluated?
- How do engineers use the engineering design process to create new products or systems to solve a problem?
- How does the engineering design process compare to the scientific method?
- What methods can be used to develop a solution to a design problem?
- What are design requirements, and how can they be identified?
- Why is building a prototype necessary?
- What are some examples of problems that cannot be solved using the engineering design process?
- How can troubleshooting be part of the design process?

Common Career Technical Core

ST-ET4

Apply the elements of the design process.

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

2. The Core Concepts of Technology

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

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Biotechnology Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

Technology Problem Solving

Transportation Modeling

Task Number 57

Describe how specifications and constraints affect the design process.

Definition

Description should include that specifications and constraints are limits that the design must stay within in order to meet the needs of the customer, or due to practical factors such as cost, time, existing technology, and laws of science.

Process/Skill Questions

- What are some examples of specifications a customer might have?
- What are some constraints that need to be considered when designing a house?
- What is a constraint that may be a result of laws of science?
- How can constraints be identified?

Common Career Technical Core

ST-ET4

Apply the elements of the design process.

ITEEA National Standards

9. Engineering Design

TSA Competitive Events

Biotechnology Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

Transportation Modeling

Task Number 58

Describe how trade-offs may be made during the design process in order to optimize a solution.

Definition

Description should include decisions to use one material over another due to factors such as strength, cost, or aesthetics; decisions to eliminate unnecessary elements; and/or decisions to meet minimum specifications in order to save resources (e.g., money, time, material).

Process/Skill Questions

- What is an example of making a trade-off on a design?
- How do trade-offs affect a design?
- What might trade-offs provide for a design?
- How is optimization important to a design?

Common Career Technical Core

ST-ET4

Apply the elements of the design process.

ITEEA National Standards

9. Engineering Design

Task Number 59

Demonstrate linear measurement techniques.

Definition

Demonstration should include standard and metric measurement techniques, using various instruments.

Process/Skill Questions

- What are fractions?
- How can you determine which number in a fraction is the numerator? Denominator?
- How are metric units different from standard units?
- What linear measurement tools can be used besides a ruler?

Common Career Technical Core

ST-ET3

Apply processes and concepts for the use of technological tools in STEM.

ST2

Use technology to acquire, manipulate, analyze and report data.

ST6

Demonstrate technical skills needed in a chosen STEM field.

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Biotechnology Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

Transportation Modeling

Task Number 60

Convey three-dimensional objects on a two-dimensional surface, using conventional and/or computer technology.

Definition

Conveying three-dimensional objects on a two-dimensional surface should include

- using sketching paper or conventional drafting tools (e.g., drafting board, T-square, triangles)
- using computer-assisted drafting software and a computer.

Producers and consumers rely on drawings to conceptualize, convey, update, and store designs. Standardization of this process is required by all countries through international treaties and standards agreements.

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-assisted drafting over conventional drafting techniques?
- What advantages does parametric modeling give a designer?
- Why is it important to standardize the way technical drawings and plans are drawn?
- Are technical drawings the property of the drafter or of his or her employer? Explain.

Common Career Technical Core

ST-ET4

Apply the elements of the design process.

ST2

Use technology to acquire, manipulate, analyze and report data.

ST6

Demonstrate technical skills needed in a chosen STEM field.

ITEEA National Standards

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Computer-Aided Design (CAD), Architecture

Computer-Aided Design (CAD), Engineering

Task Number 61

Describe the characteristics and/or properties of materials.

Definition

Description should include the processes for the identification of characteristics, properties, and testing of materials (i.e., wood, metal, polymers, and composites).

Process/Skill Questions

- What are some material properties?
- How would you test the strengths of materials?
- What are renewable materials?

ITEEA National Standards

11. Apply the Design Process

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

14. Medical Technologies

15. Agricultural and Related Biotechnologies

16. Energy and Power Technologies

18. Transportation Technologies

19. Manufacturing Technologies

20. Construction Technologies

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

TSA Competitive Events

Biotechnology Design

Engineering Design

Task Number 62

Propose a solution to an assigned technological problem by applying processes and resources.

Definition

The proposed solution should be accompanied by documentation of the steps, processes, and resources used to solve the problem.

Process/Skill Questions

- What processes are used to complete products?
- How can the selection of resources affect the output of a system?
- What is a description of a problem-solving model?
- Why are product designs modified?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST2

Use technology to acquire, manipulate, analyze and report data.

ITEEA National Standards

11. Apply the Design Process

9. Engineering Design

TSA Competitive Events

Architectural Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

System Control Technology

Transportation Modeling

Video Game Design

Task Number 63

Formulate a problem statement for the assigned technological problem to be solved.

Definition

Formulation of a problem statement for a technological problem should include a minimum of one complete sentence that presents the technological challenge and its importance. Elements should include

- terminology
- clarity
- completeness
- focus.

Process/Skill Questions

- What is a technological problem?
- Why is it important to state a technological problem before trying to solve it?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET2

Display and communicate STEM information.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ITEEA National Standards

11. Apply the Design Process

TSA Competitive Events

Biotechnology Design

Computer Integrated Manufacturing (CIM)

Engineering Design

System Control Technology

Technology Problem Solving

Video Game Design

Task Number 64

Design a product or system to solve the problem statement for the assignment.

Definition

Design should include

- selecting areas of technology
- gathering information about the product
- creating ideas, sketches, notes, and graphics for solutions
- selecting the best solution
- marketing the product for a specific audience
- documenting the design process in a portfolio.

Process/Skill Questions

- What factors are important when designing a product?
- What is brainstorming, and how is it useful in product design?
- What criteria should be used to select the best solution?
- What is the importance of documenting, sketching, and note taking in product design?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ITEEA National Standards

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

System Control Technology

Transportation Modeling

Video Game Design

Task Number 65

Construct a working prototype of the assigned design problem.

Definition

Construction should be a working model made with the material that will be used in the product, and it should be used to test the design and make adjustments, if necessary.

Process/Skill Questions

- What is the difference between a model and a prototype?

- What is the purpose of creating a prototype?
- How is a prototype a representation of a product?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET3

Apply processes and concepts for the use of technological tools in STEM.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST3

Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

ST6

Demonstrate technical skills needed in a chosen STEM field.

ITEEA National Standards

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

19. Manufacturing Technologies

9. Engineering Design

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

System Control Technology

Video Game Design

Task Number 66

Evaluate the prototype through testing.

Definition

Evaluation of the prototype should be based upon physical testing, experimentation, criteria, and appropriateness of materials and processes. These components will be determined by data collected throughout the testing process.

Process/Skill Questions

- What test results prove that the process works?
- What modification might be needed to solve the problems identified?
- What methods can be used to determine the accuracy of the information collected?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST2

Use technology to acquire, manipulate, analyze and report data.

ST6

Demonstrate technical skills needed in a chosen STEM field.

ITEEA National Standards

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

Computer Integrated Manufacturing (CIM)

Engineering Design

System Control Technology

Video Game Design

Producing a Technological Solution

Task Number 67

Design a technological solution for a problem as part of a team.

Definition

Designing a technological solution as part of a team requires that problem-solving skills be used to find the best (e.g., most efficient, most appropriate, most cost-effective) solution to a technical problem and should consist of the following:

- Identify the problem and design constraint.
- Organize a plan for the solution.
- Identify materials and tools.
- Use materials and tools to construct the solution.

Process/Skill Questions

- What are some roles on a team?
- How can teamwork help in finding an optimal solution?
- What are some difficulties of working as a team?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ST2

Use technology to acquire, manipulate, analyze and report data.

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

15. Agricultural and Related Biotechnologies

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Architectural Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

System Control Technology

Transportation Modeling

Video Game Design

Task Number 68

Select technologies and resources to solve a problem as a team.

Definition

Selection should include the processes and resources used to build the product that solves a technological problem.

Process/Skill Questions

- What processes are used to complete a product?
- How can the selection of resources affect the output of a system?
- Why are product designs modified?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET3

Apply processes and concepts for the use of technological tools in STEM.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ITEEA National Standards

11. Apply the Design Process

9. Engineering Design

TSA Competitive Events

Architectural Design

Computer Integrated Manufacturing (CIM)

Dragster Design

Engineering Design

Flight Endurance

System Control Technology

Transportation Modeling

Task Number 69

Refine the solution, using problem-solving and teamwork skills.

Definition

Refined solution should include documentation of its development and the problem-solving and teamwork skills used to help reorganize the outcome or solution.

Process/Skill Questions

- What are the steps in the problem-solving method?
- How would you anticipate, identify, and fix potential problems in a system?
- What resources would you use to solve a problem?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

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

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

Flight Endurance

System Control Technology

Video Game Design

Task Number 70

Produce the result of the design process.

Definition

Production should include use of technological resources required by the design.

Process/Skill Questions

- What challenges did you face working as part of the team?
- What skills did you improve by working on this process?
- What resources would have improved the team's ability to solve the problem?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET3

Apply processes and concepts for the use of technological tools in STEM.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ST3

Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

ST6

Demonstrate technical skills needed in a chosen STEM field.

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

Flight Endurance

Transportation Modeling

Video Game Design

Evaluating a Technological Solution

Task Number 71

Evaluate the solution by comparing it with the problem statement.

Definition

Evaluation should include

- reviewing the problem statement
- describing the solution
- determining the extent to which the solution solves the problem
- making suggestions for improving the existing solution
- identifying additional ways the problem could be solved.

Process/Skill Questions

- Why is it important to evaluate a solution against the problem statement?

- How might a solution satisfy the original wants and needs of people in school, at home, in the community, or throughout the world?
- How might a solution use resources to satisfy these wants and needs?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ST2

Use technology to acquire, manipulate, analyze and report data.

ITEEA National Standards

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

Flight Endurance

Transportation Modeling

Video Game Design

Task Number 72

Assess the impact of the product on individuals, resources, society, and the environment.

Definition

Assessment should be based on research and/or simple class surveys depicting the positive or negative impact that the product has on resources, the environment, and people.

Process/Skill Questions

- What effect does the particular product have on people and society?
- How would the use of different resources affect the system?
- How does data assist people in making informed choices relating to new product technology?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ST4

Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.

ST6

Demonstrate technical skills needed in a chosen STEM field.

ITEEA National Standards

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

5. The Effects of Technology on the Environment

6. The Role of Society in the Development and Use of Technology

TSA Competitive Events

Biotechnology Design

Task Number 73

Produce a technical report as part of a team.

Definition

Production of a technical report should cover all expectations and costs of production and include final drawings, test results, and charts.

Process/Skill Questions

- What criteria were used to identify the selected prototype ideas?
- What data was used to design and evaluate the prototype model?
- What evaluation methods were used to determine trends that influenced the design outcome?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET2

Display and communicate STEM information.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ST2

Use technology to acquire, manipulate, analyze and report data.

ITEEA National Standards

13. Assess the Impact of Products and Systems

17. Information and Communication Technologies

9. Engineering Design

TSA Competitive Events

Engineering Design

System Control Technology

Task Number 74

Present a final project report as part of a team.

Definition

Presentation of a final project report should communicate factors influencing the prototype design solution, using any of the following:

- Computers
- Design portfolio
- Research
- Models
- Displays
- Multimedia software packages

Process/Skill Questions

- What factors influenced the prototype design solutions?
- What criteria can be used to evaluate the presentation?
- What methods can be used to develop a presentation?

Common Career Technical Core

ST-ET1

Use STEM concepts and processes to solve problems involving design and/or production.

ST-ET2

Display and communicate STEM information.

ST-ET4

Apply the elements of the design process.

ST-ET5

Apply the knowledge learned in STEM to solve problems.

ST1

Apply engineering skills in a project that requires project management, process control and quality assurance.

ST2

Use technology to acquire, manipulate, analyze and report data.

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

13. Assess the Impact of Products and Systems

17. Information and Communication Technologies

TSA Competitive Events

Computer Integrated Manufacturing (CIM)

Engineering Design

Prepared Presentation

Video Game Design

SOL Correlation by Task

39	Define <i>technology</i> .	English: 9.3, 10.3, 11.3, 12.3
40	Identify the importance of technology in everyday life.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.12, VUS.13, VUS.14, WG.17, WHII.13, WHII.14 Science: PH.4
41	Describe the importance of technology in the development of society and the environment.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.12, VUS.13, VUS.14, WG.16, WG.17, WG.18, WHII.13, WHII.14 Science: PH.4
42	List examples of emerging technologies.	English: 9.6, 10.6, 11.6, 12.6 History and Social Science: VUS.13, VUS.14, WHII.13, WHII.14 Science: PH.4
43	Predict technological changes.	English: 9.5, 10.5, 11.5, 12.5

		History and Social Science: VUS.14, WG.17, WHII.14 Mathematics: A.9, AII.9, PS.1*, PS.2*, PS.3*, PS.4*, PS.7*
44	Describe ways society influences the creation of certain technologies.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.9, GOVT.15, VUS.13, VUS.14, WHII.13, WHII.14 Science: PH.4
45	Assess the impact of technology on individuals, resources, society, and the environment.	English: 9.5, 9.6, 9.7, 9.8, 10.5, 10.6, 10.7, 10.8, 11.5, 11.6, 11.7, 11.8, 12.5, 12.6, 12.7, 12.8 History and Social Science: VUS.13, VUS.14, WG.3, WG.17, WHII.13, WHII.14 Mathematics: PS.1*, PS.13, PS.2*, PS.3*, PS.7*, PS.8*, PS.9* Science: PH.4
46	Explore career opportunities to determine occupational and educational choices.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8 History and Social Science: GOVT.7, GOVT.8, GOVT.9, GOVT.14, GOVT.15
47	Present information regarding technological solutions to human problems, using various technologies.	English: 9.1, 10.1, 11.1, 12.1 History and Social Science: GOVT.1
48	Identify the core concepts of technology.	English: 9.5, 10.5, 11.5, 12.5
49	Analyze a basic technological system.	English: 9.5, 10.5, 11.5, 12.5 Mathematics: COM.7, COM.9, COM.10, COM.11, COM.15, COM.16
50	Analyze technological resources.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.9, GOVT.15, WG.3, WG.16, WG.17
51	Compare sources of energy, types of sustainable energies, and energy converters.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.6, PH.7
52	Describe how tool and machine resources provide various processes.	English: 9.5, 10.5, 11.5, 12.5

53	Illustrate the ways processes change input resources into outputs in a manufacturing system.	
54	Describe ways that people control technology.	Mathematics: COM.7, COM.9, COM.10, COM.11, COM.15, COM.16
55	Apply safety procedures and practices.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.7, GOVT.8, GOVT.9, WHII.8 Science: CH.1
56	Explain the engineering design process.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1 Mathematics: AII.3, AII.7, AII.9, COM.1, COM.2, COM.3, COM.4, COM.7, COM.8, COM.9, COM.10, COM.11, COM.13, COM.14, COM.15, COM.17, COM.18, MA.1, MA.2, MA.7, MA.8 Science: PH.1
57	Describe how specifications and constraints affect the design process.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1
58	Describe how trade-offs may be made during the design process in order to optimize a solution.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1
59	Demonstrate linear measurement techniques.	Mathematics: G.8 Science: PH.2
60	Convey three-dimensional objects on a two-dimensional surface, using conventional and/or computer technology.	English: 9.2, 10.2, 11.2, 12.2 Mathematics: G.3, G.13
61	Describe the characteristics and/or properties of materials.	English: 9.5, 10.5, 11.5, 12.5 Science: CH.6
62	Propose a solution to an assigned technological problem by applying processes and resources.	English: 9.1, 9.2, 10.1, 10.2, 11.1, 11.2, 12.1, 12.2 History and Social Science: GOVT.1 Science: PH.1
63	Formulate a problem statement for the assigned technological problem to be solved.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7 History and Social Science: GOVT.1

		Science: PH.1
64	Design a product or system to solve the problem statement for the assignment.	English: 9.1, 9.6, 10.1, 10.6, 11.1, 11.6, 12.1, 12.6 History and Social Science: GOVT.1 Science: PH.2
65	Construct a working prototype of the assigned design problem.	Science: PH.1
66	Evaluate the prototype through testing.	English: 9.5, 10.5, 11.5, 12.5 Mathematics: AFDA.8, PS.8*, PS.10* Science: PH.1
67	Design a technological solution for a problem as part of a team.	English: 9.1, 9.2, 10.1, 10.2, 11.1, 11.2, 12.1, 12.2 History and Social Science: GOVT.1 Science: PH.1
68	Select technologies and resources to solve a problem as a team.	English: 9.2, 9.5, 10.2, 10.5, 11.2, 11.5, 12.2, 12.5 Science: PH.1
69	Refine the solution, using problem-solving and teamwork skills.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1 Science: PH.1
70	Produce the result of the design process.	English: 9.2, 10.2, 11.2, 12.2 Science: PH.1
71	Evaluate the solution by comparing it with the problem statement.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1 Mathematics: G.1 Science: PH.1
72	Assess the impact of the product on individuals, resources, society, and the environment.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: GOVT.1, GOVT.9, GOVT.15, WG.17, WG.18 Mathematics: AFDA.8, PS.8*, PS.10* Science: PH.4

73	Produce a technical report as part of a team.	English: 9.1, 9.6, 9.7, 10.1, 10.6, 10.7, 11.1, 11.6, 11.7, 12.1, 12.6, 12.7 Science: PH.1
74	Present a final project report as part of a team.	English: 9.1, 9.2, 10.1, 10.2, 11.1, 11.2, 12.1, 12.2 Science: PH.1

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

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- National Career Readiness Certificate Assessment
- Workplace Readiness Skills for the Commonwealth Examination