Technology Transfer

8404 18 weeks

8405 36 weeks

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Course Description

Suggested Grade Level: 10 or 11 or 12
Prerequisites: 8402 or 8403

Students learn how existing technologies developed for one purpose can be applied to a different function. Groups work together, applying science, technology, engineering and mathematics (STEM) concepts to projects. Students engage in hands-on activities to learn that the transfer of a technology from one society to another can cause cultural, social, economic, and political challenges.

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	8405	8404	Tasks/Competencies
Evaluating Effects of Technological Systems			
39	⊕	⊕	Explain technology transfer.
40	⊕	⊕	Review the major technological contexts.
41	⊕	⊕	Identify technological systems.
42	⊕	⊕	Analyze the connections among technological systems.
43	⊕	⊕	Describe how interdisciplinary thinking enhances technology transfer.
44	⊕	⊕	Analyze the contributions of technology to economic systems.
45	⊕	⊕	Evaluate the effects of technology on society, cultures, and the environment.
46	⊕	⊕	Explain the concept of appropriate technology.
47	⊕	○	Analyze career opportunities in a variety of technological fields.
48	⊕	⊕	Review proven technologies for possible enhancements or different uses.
49	⊕	⊕	Explain the concept of intellectual property.
Applying the Engineering Design Process in STEM			
50	⊕	⊕	Analyze how universal components make up a technological system.
51	⊕	○	Create an example of a theoretical system.
52	⊕	⊕	Identify the steps of the engineering design process.

53	⊕	⊕	Identify the components of an engineering design portfolio.
54	⊕	⊕	Apply modeling and simulation techniques.
55	⊕	⊕	Identify mathematical terms and procedures that are applicable to technology.
56	⊕	⊕	Identify scientific laws and principles that are applicable to technology.

Applying Technological Processes

57	⊕	⊕	Propose a technology transfer.
58	⊕	⊕	Model a proposed technology transfer using engineering techniques and processes.
59	○	○	Diagram the material flow through the supply chain.
60	○	○	Modify a quality assurance plan.
61	⊕	⊕	Identify tools, machines, materials, and processes needed for a proposed technology transfer.
62	⊕	⊕	Identify safety considerations specific to a proposed technology transfer.
63	⊕	⊕	Evaluate a proposed technology transfer.

Demonstrating Teamwork in Technology Transfer Problem Solving

64	⊕	⊕	Organize an engineering design project team.
65	⊕	⊕	Use team feedback to improve technological systems.
66	⊕	⊕	Resolve conflict within a team.
67	⊕	⊕	Employ active-listening techniques in an engineering team.
68	⊕	⊕	Explain the benefits of active listening.
69	⊕	⊕	Explain the benefits of multiple perspectives and diverse skills in solving real-world problems.
70	⊕	⊕	Evaluate the team process.

71	⊕	⊕	Perform responsibilities as defined by serving on a design engineering team.
72	⊕	⊕	Transfer a technology system, process, or artifact to solve a problem.
73	⊕	⊕	Present a technology transfer solution as a team.
74	⊕	○	Evaluate the effectiveness of group dynamics.

Legend: ⊕Essential ○Non-essential ⊖Omitted

Curriculum Framework

Evaluating Effects of Technological Systems

Task Number 39

Explain technology transfer.

Definition

Explanation should include that technology transfer is the process by which technology or knowledge developed in one place or for one purpose is applied and used in another.

Process/Skill Questions

- What are examples of technology transfer used in daily life?
- How can technologies developed for the government be applied to other purposes to fulfill public and private needs?

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

Task Number 40

Review the major technological contexts.

Definition

Review should include the major technological contexts:

- energy and power technologies
- agriculture and biotechnologies
- information and communication technologies
- manufacturing technologies
- construction technologies of the built environment
- transportation and logistics technologies
- medical and health-related technologies
- automation, computation, artificial intelligence, and robotics technologies.

Process/Skill Questions

- What is an example of technology transfer in energy and power?
- What are examples of technology transfer in agriculture and biotechnologies?
- What are examples of technology transfer in information and communication?
- What is an example of technology transfer in manufacturing?
- What is an example of technology transfer in construction?
- What is an example of technology transfer in transportation and logistics?
- What is an example of technology transfer in medical and health-related technologies?
- What is an example of technology transfer in automation, computation, artificial intelligence, and robotics technologies?
- How is biotechnology used in both agriculture and medicine?

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

TSA Competitive Events

Biotechnology Design

Engineering Design

Transportation Modeling

Task Number 41

Identify technological systems.

Definition

Identification should include material objects of use to humanity, such as machines, hardware, methods of organization, and techniques.

Process/Skill Questions

- What is meant by technological system?
- How is a machine or device a system?

ITEEA National Standards

2. The Core Concepts of Technology

Task Number 42

Analyze the connections among technological systems.

Definition

Analysis should include the relationships among different technological systems, including how they interact with one another.

Process/Skill Questions

- What technological methods contributed to students arriving at school today?
- How are these methods interconnected?
- Why is it important for technological systems to be associated with other systems?

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

Task Number 43

Describe how interdisciplinary thinking enhances technology transfer.

Definition

Description should include citing examples of technology transfer enhanced by the knowledge of a variety of disciplines.

Process/Skill Questions

- What are examples of technology transfer from the National Aeronautics and Space Administration (NASA) and the U.S. Department of Defense (DOD)?
- How can the arts influence the development of technology?
- What is STEM/STEAM thinking (e.g., the DaVinci Program at Virginia Commonwealth University)?
- What is an example of a simple technology transfer that might happen in day-to-day life.

ITEEA National Standards

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

13. Assess the Impact of Products and Systems

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

Task Number 44

Analyze the contributions of technology to economic systems.

Definition

Analysis should include positive and negative contributions to economic systems that have occurred via the implementation of technology.

Process/Skill Questions

- In what ways has technology contributed to local or state economies?
- In what ways has technology contributed to different economic systems throughout the world?
- What are some negative effects of technological advancements? How might they be minimized or eliminated?
- How might a technology negatively affect a job?

ITEEA National Standards

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

Task Number 45

Evaluate the effects of technology on society, cultures, and the environment.

Definition

Evaluation should include the positive and negative effects on society, cultures, and the natural environment that have occurred throughout the developments of technology.

Process/Skill Questions

- What environmental trade-offs must be considered when implementing new technological systems?
- What economic trade-offs must be considered when implementing new technological systems?

- How do cultural values influence technological advancements?
- What political changes could result from implementing new technological systems?
- What are examples of technologies that affect environmental systems?
- How can technologies contribute to business, environmental, and economic sustainability?
- What are examples of technologies that affect human health?

ITEEA National Standards

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

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Task Number 46

Explain the concept of appropriate technology.

Definition

Explanation should include that appropriate technology seeks to "aid and support the human ability to understand, operate, and sustain technological systems to the benefit of humans while having the least negative societal and environmental impact on communities." (excerpt from the former Office of Technology Assessment, 1981)

Process/Skill Questions

- How do you determine the appropriate technology for a situation?
- What is a situation that might benefit from technology?
- What are the differences and similarities in the use of technology in developed, emerging, and developing nations?
- What are some of the environmental and economic implications of using technology?
- When does a technology become inappropriate?
- What technologies exist that may be perceived to invade one's privacy?
- How do different cultures weigh privacy vs. security?

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

7. The Influence of Technology on History

Task Number 47

Analyze career opportunities in a variety of technological fields.

Definition

Analysis should include research pertaining to local opportunities and the skills required for diverse career opportunities, as well as the benefits and drawbacks of working in these careers.

Career exploration methods may include visiting various local businesses and performing job shadowing or other work-based learning.

Resources:

- Virginia Career VIEW
- O*Net
- Center for Energy Workforce Development
- Virginia Education Wizard
- Job search sites (e.g., Indeed, Monster, Glassdoor, LinkedIn)

Process/Skill Questions

- What are some career opportunities in energy and power?
- What are some career opportunities in information and communication?
- What are the educational requirements for specific careers?
- What criteria should be considered when selecting a career?
- What are the salary ranges in specific careers?
- What new career fields are emerging?
- What are publicly available career information resources?
- What technologies are used in your career of choice?

ITEEA National Standards

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

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Task Number 48

Review proven technologies for possible enhancements or different uses.

Definition

Review should include that an innovation is an enhancement to an existing technology, while an adaptation is using a technology for a purpose other than originally intended.

Process/Skill Questions

- How do you select proven technologies as candidates for possible enhancements?
- What process should be used to design and build enhancements to or adaptations from existing systems?
- What trade-offs need to be considered?
- What are examples of a technology that could be used for multiple purposes?

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 49

Explain the concept of intellectual property.

Definition

Explanation should include

- defining *intellectual property* (e.g. designs, manuscripts, patents, copyrights, trademarks, trade secrets)
- listing laws and regulations pertaining to intellectual property, including import/export control laws.

Process/Skill Questions

- Which laws apply to technology transfer activities?
- What legal issues need to be addressed when transferring technology to other countries?
- What are nonexclusive, partially exclusive, and exclusive licenses?

- What is a patent process?
- How can one verify whether a technology has been patented?

ITEEA National Standards

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

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Applying the Engineering Design Process in STEM

Task Number 50

Analyze how universal components make up a technological system.

Definition

Analysis should include the combination of resources and processes working together to produce a desired result. The universal systems model includes the following components:

- Input
- Process
- Output
- Feedback

Process/Skill Questions

- What parts make up the input component of the universal systems model?
- What parts make up the process component of the universal systems model?
- What occurs in the output component?
- Why is feedback important when using the universal systems model?
- What are the input, process, output, and feedback components of a system you use every day?

ITEEA National Standards

Task Number 51

Create an example of a theoretical system.

Definition

Creation of an example should include the identification of input, process, output, and feedback components.

Process/Skill Questions

- What is the purpose of the system?
- What are examples of the inputs to the system?
- What are examples of processes in a system?
- What are examples of outputs of the system?
- How is the system controlled using feedback?
- What can be done to improve the system?

ITEEA National Standards

2. The Core Concepts of Technology

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

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Task Number 52

Identify the steps of the engineering design process.

Definition

Identification should include the following steps:

- Identify the need or opportunity for an engineering solution.
- Define an engineering design problem.
- Identify the criteria (i.e., requirements) and constraints (i.e., restrictions/limits) of the design problem.
- Research potential solutions to the design problem.

- Generate (i.e., brainstorm) multiple solutions to the design problem.
- Sketch the solutions to the design problem.
- Evaluate the requirements and constraints of each solution to the design problem.
- Justify an optimal solution to the design problem.
- Create a model or prototype for the chosen solution to the design problem, using appropriate materials and processes.
- Determine the objectives for an engineering test of the solution to the design problem.
- Test the solution to the design problem, using mathematical, conceptual, and/or physical modeling, simulating, and optimizing.
- Evaluate the test results.
- Formulate an alternate solution to the design problem, if needed.
- Test the alternate solution, if needed.
- Present the final project report.
- Document the final project report.

Process/Skill Questions

- How does the engineering design process differ from the scientific method?
- What is the most crucial step in the engineering design process? Why?
- Why can the engineering design steps be completed in more than one order?
- How would one simplify this engineering design process to fewer steps?

ITEEA National Standards

9. Engineering Design

TSA Competitive Events

Engineering Design

Task Number 53

Identify the components of an engineering design portfolio.

Definition

Identification of the components of an engineering design portfolio may include

- title page
- introduction
- problem statement
- design brief and specifications

- research and investigation
- brain storming solutions
- selected solution
- implementation and development work
- final testing and overall evaluation
- a work log.

The engineering design portfolio is a compilation of records that are kept in various forms throughout the design and problem-solving process.

Process/Skill Questions

- What are the key elements of an engineering design portfolio?
- What is the importance of creating an engineering portfolio?
- What is the difference between a concept sketch and a design sketch?
- Why is an engineering design portfolio important in a patent process?
- What are some reasons to maintain a paper trail?
- How can you create a working model of your design?
- Why is it important to document the design process?

ITEEA National Standards

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

9. Engineering Design

TSA Competitive Events

Engineering Design

Task Number 54

Apply modeling and simulation techniques.

Definition

Application may include

- using sketching paper or conventional drafting tools
- using computer-assisted drafting software and a computer
- using 3D modeling software to show objects in three-dimensional space

- using software to analyze the strengths and weaknesses of a design
- using animation software or automation, computation, AI, and robotics technologies
- using mathematical modeling.

Process/Skill Questions

- Why is it important to standardize the way technical drawings and plans are drawn?
- What are some of the major types of graphic drawings?
- 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 advantages of computer-assisted drafting over conventional drafting techniques?

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

TSA Competitive Events

3D Animation

Task Number 55

Identify mathematical terms and procedures that are applicable to technology.

Definition

Identification should include applications of mathematical concepts, such as

- distance
- units
- statistics
- graphing
- angles
- triangles
- vectors
- proportions

- spacing
- symmetry
- ratios
- formulas.

To understand the influence of technology on society, one must know how to interpret this language using various formulas, charts, forecasting models, and other resources.

Process/Skill Questions

- How do mathematical concepts affect life?
- What problems can result from mixing components of different measuring systems (i.e., English and metric)?
- How can statistics and graphics be used to make decisions?
- What effect can angles, triangles, and vectors have on decision making?

ITEEA National Standards

2. The Core Concepts of Technology

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

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Task Number 56

Identify scientific laws and principles that are applicable to technology.

Definition

Identification may include Newton's laws of motion, the law of conservation of energy, laws of thermodynamics, electrostatics, Bernoulli's principle, and other aspects of science related to the technology being studied.

Process/Skill Questions

- How are science and technology related?
- How does technology help prove scientific concepts?

ITEEA National Standards

2. The Core Concepts of Technology

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

TSA Competitive Events

Biotechnology Design

Applying Technological Processes

Task Number 57

Propose a technology transfer.

Definition

Proposal should include

- identifying a problem, challenge, or need
- brainstorming existing technologies that may address the problem, challenge, or need.

Process/Skill Questions

- What problems might exist that could be solved using existing technology?
- How can one apply innovation or adaptation to solve these problems?

ITEEA National Standards

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

8. The Attributes of Design

9. Engineering Design

Task Number 58

Model a proposed technology transfer using engineering techniques and processes.

Definition

Modeling should include the use of various approaches to predict outcomes and evaluate design solutions.

Process/Skill Questions

- Why is modeling important?
- What are some common modeling techniques?
- What materials are often used for modeling?
- How can modeling save money?

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 59

Diagram the material flow through the supply chain.

Definition

Diagram should include how materials flow through the supply chain, from raw material to a final delivered product.

Process/Skill Questions

- From where do raw materials come?
- How are raw materials transported?
- How are raw materials processed?
- What happens to raw materials after they have been processed?
- What are other steps in the supply chain?
- What kinds of relationships exist within the supply chain?

ITEEA National Standards

Task Number 60

Modify a quality assurance plan.

Definition

Modification should include

- standards
- testing
- failure analysis
- data collection
- improvement plan.

Process/Skill Questions

- Why should there be a quality assurance plan in place?
- What standards exist for quality assurance?
- Who benefits from quality assurance? How?

Task Number 61

Identify tools, machines, materials, and processes needed for a proposed technology transfer.

Definition

Identification should include safe practices to produce, test, and evaluate objects as needed for a proposed technology transfer.

Process/Skill Questions

- Why is it important to use the right tool for the job?
- What emergency procedures should be followed if an accident occurs?
- What processes are used to produce the transfer?
- What tools are needed for the assembly of the technology being proposed?

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

8. The Attributes of Design

9. Engineering Design

Task Number 62

Identify safety considerations specific to a proposed technology transfer.

Definition

Identification may include

- using or modifying safety resources (e.g., safety data sheets [SDS], personal protective equipment [PPE])
- potential dangers or hazards when innovating or adapting a technology
- considering the use of new tools, machines, or materials
- potential consequences (i.e., intended, unintended, positive, negative).

Process/Skill Questions

- How would you analyze your technology for safety hazards and violations? What are ways the hazards or violations could be eliminated?
- What are some possible health effects of exposure to this technology?
- What safety precautions can be identified for the consumer?

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 63

Evaluate a proposed technology transfer.

Definition

Evaluation should include

- determining how well the solution met the criteria and constraints
- formulate an alternate solution, if needed
- testing the alternate solution
- presenting the solution
- documenting the solution using one's engineering design portfolio.

Process/Skill Questions

- Where can improvements be made?
- What are some methods for presenting the solution?
- How would one market one's proposed technology transfer?

ITEEA National Standards

13. Assess the Impact of Products and Systems

Demonstrating Teamwork in Technology Transfer Problem Solving

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Task Number 64

Organize an engineering design project team.

Definition

Organization should include

- interpreting the stakeholders' goals
- identifying the design problem
- using the engineering design process
- determining the skills required for the project
- coordinating team members according to their skill sets (e.g., subject matter experts)
- delegating/assigning team roles
- determining communication methods within the team and between the team and stakeholders.

Process/Skill Questions

- What are the team's shared goals?
- How can each team member use their talents to accomplish the team's goals?
- What are the criteria and constraints of this design problem?
- How will team members communicate progress, questions, or requests for help?
- Why is it desirable to have team members with varying backgrounds and expertise?

ITEEA National Standards

13. Assess the Impact of Products and Systems

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

9. Engineering Design

Task Number 65

Use team feedback to improve technological systems.

Definition

Use of team feedback should consist of

- delivering constructive criticism about the problem solution or design
- maintaining a professional demeanor
- keeping an open mind and a willingness to listen
- applying feedback to optimize the design or solve the problem.

Process/Skill Questions

- How can feedback be delivered in a constructive manner?
- How is feedback used to improve design?
- What is meant by professionalism?
- How can feedback be applied to improve the technological system?

ITEEA National Standards

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

TSA Competitive Events

Engineering Design

Task Number 66

Resolve conflict within a team.

Definition

Resolution may include using the following modes of conflict management:

- Accountability
- Avoiding
- Accommodating
- Competing
- Compromising
- Collaborating

If the conflict cannot be resolved, a formal grievance process is typically offered as a final alternative.

Process/Skill Questions

- What causes conflict within a team?
- How can conflict within a team be avoided?
- How is accountability assigned?
- To what situation would each conflict-resolution method apply?
- What is the difference between conflict and disagreement?

Task Number 67

Employ active-listening techniques in an engineering team.

Definition

Employment of active-listening techniques should include

- expressing interest through actions and facial expressions
- paraphrasing key points back to the speaker
- asking questions at appropriate times
- maintaining eye contact
- refraining from interrupting the speaker
- stopping all other activities (e.g., turning off music, turning away from a computer, setting papers down)
- keeping comments brief and on topic.

Process/Skill Questions

- What is meant by active listening?
- How would you demonstrate effective listening skills (e.g., through role-playing)?
- How would you demonstrate ineffective listening skills (e.g., through role-playing)?

ITEEA National Standards

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

TSA Competitive Events

Engineering Design

Task Number 68

Explain the benefits of active listening.

Definition

Explanation should include that active listening

- reduces assumptions
- clarifies the content of the message between the sender and the receiver
- establishes common understanding and expectations
- encourages future communication.

Process/Skill Questions

- How does courtesy influence active-listening skills?
- How does active listening encourage additional communication and ideas?
- How does active listening reduce assumptions?

ITEEA National Standards

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

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Task Number 69

Explain the benefits of multiple perspectives and diverse skills in solving real-world problems.

Definition

Explanation should include the way a diverse and inclusive team

- engages every team member
- recognizes cultural differences
- increases the number of potential solutions
- enhances alternatives

- pools knowledge
- encourages collaboration
- encourages teamwork
- improves the quality of solutions.

Process/Skill Questions

- What is meant by multiple perspectives?
- What are some examples of diverse skills?
- How might you educate a team about addressing cultural differences?
- How does not recognizing cultural differences adversely affect the team and the project?
- Why is inclusion beneficial to a team?
- How can one foster an environment in which everyone on the team feels comfortable sharing their ideas?

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

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

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Task Number 70

Evaluate the team process.

Definition

Evaluation should include the team member roles, the effectiveness of the solution, and the use of processes like active listening.

Process/Skill Questions

Note: These questions can be written in a survey format.

- What part of your responsibility was enjoyable? Not enjoyable?
- What helped you overcome the negative aspects of any unpleasant task or tasks?
- Did you leave any assigned tasks undone or partially done? Why? What would have helped motivate you to fully accomplish the task?

- Do you feel your opinion mattered in the group's decision-making process? How do you think that feeling affected your ability or motivation to accomplish your part of the task?

ITEEA National Standards

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

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Task Number 71

Perform responsibilities as defined by serving on a design engineering team.

Definition

Performance on a design engineering team should include the responsibilities of each member of the team to accomplish assigned tasks.

Process/Skill Questions

- How will active listening assist your team in devising a plan for solving the design problem?
- How is promptness important to design team success?

TSA Competitive Events

Engineering Design

Task Number 72

Transfer a technology system, process, or artifact to solve a problem.

Definition

The transfer process should include documentation of the method used to arrive at a solution to a given problem.

Process/Skill Questions

- What is the problem?
- What are the requirements?
- What are the constraints?
- What are possible solutions?
- What are the advantages and disadvantages of the solutions?

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

8. The Attributes of Design

9. Engineering Design

Task Number 73

Present a technology transfer solution as a team.

Definition

Presentation should use documentation and explanations from each team member about their role in the process, and include the following elements:

- 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
- completing the presentation within the allotted time.

Process/Skill Questions

- Why is it important to explain both the part you played on a team and why you played that part?
- How would you explain the trade-offs made to optimize the design?
- Why is clear documentation necessary for an engineering design team?
- How will you prepare for possible questions about your design?

ITEEA National Standards

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

TSA Competitive Events

Biotechnology Design

Engineering Design

Prepared Presentation

Task Number 74

Evaluate the effectiveness of group dynamics.

Definition

Evaluation may include

- identifying the conflicts and successes of group interactions
- self-evaluation
- team evaluation.

Process/Skill Questions

Note: These questions could be asked in a survey or teacher-made evaluation format.

- What areas of communication between group members worked well? Poorly?
- Did group members experience frustration? Why? What could have been done differently?
- Did breakdowns in communication occur? What were the effects?
- Were there problems with the willingness or ability of a group member to perform a necessary task? How could this problem have been solved?
- What could be changed in the group's dynamics to improve compatibility?

ITEEA National Standards

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

SOL Correlation by Task

39	Explain technology transfer.	English: 10.4, 11.5, 12.5
40	Review the major technological contexts.	English: 10.4, 11.5, 12.5 History and Social Science: VUS.8, VUS.14, WG.4, WG.17, WHII.8, WHII.14
41	Identify technological systems.	English: 10.4, 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
42	Analyze the connections among technological systems.	English: 10.4, 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
43	Describe how interdisciplinary thinking enhances technology transfer.	English: 10.4, 11.5, 12.5 History and Social Science: VUS.14, WG.17, WHII.14
44	Analyze the contributions of technology to economic systems.	English: 10.4, 11.5, 12.5 History and Social Science: GOVT.14, GOVT.15
45	Evaluate the effects of technology on society, cultures, and the environment.	History and Social Science: GOVT.14, GOVT.15, 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, WG.15, WG.16, WG.17, WHI.2, WHI.3, WHI.4, WHI.5, WHI.6, WHI.8, WHI.9, WHI.10, WHI.11, WHI.12, WHI.13, WHI.14, WHI.15, 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
46	Explain the concept of appropriate technology.	English: 10.4, 11.5, 12.5 History and Social Science: GOVT.14, GOVT.15, 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, WG.15, WG.16, WG.17, WHI.2, WHI.3, WHI.4, WHI.5, WHI.6, WHI.8, WHI.9, WHI.10, WHI.11, WHI.12, WHI.13, WHI.14, WHI.15, 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
47	Analyze career opportunities in a variety of technological fields.	English: 10.4, 10.8, 11.5, 11.8, 12.5, 12.8 History and Social Science: GOVT.14, GOVT.15
48	Review proven technologies for possible enhancements or different uses.	English: 10.4, 10.8, 11.5, 11.8, 12.5, 12.8
49	Explain the concept of intellectual property.	English: 10.4, 11.3, 11.5, 12.3, 12.5 History and Social Science: GOVT.14, GOVT.15, VUS.14, WG.17, WHII.14
50	Analyze how universal components make up a technological system.	English: 10.4, 11.5, 12.5 Mathematics: COM.11
51	Create an example of a theoretical system.	English: 10.4, 11.3, 12.3 Mathematics: COM.1, COM.2, COM.3, COM.4, COM.6, COM.7, COM.8, COM.9
52	Identify the steps of the engineering design process.	English: 10.4, 10.6, 10.7, 11.3, 11.5, 11.6, 11.7, 11.8, 12.3, 12.5, 12.6, 12.7, 12.8
53	Identify the components of an engineering design portfolio.	English: 10.4, 11.5, 11.8, 12.5, 12.8
54	Apply modeling and simulation techniques.	English: 10.4, 11.5, 12.5 Mathematics: G.14, AFDA.1, AFDA.2, AFDA.3, AFDA.4, AII.7, AII.8, MA.2, MA.3, MA.10
55	Identify mathematical terms and procedures that are applicable to technology.	English: 10.4, 11.5, 12.5 History and Social Science: WHI.5, WHI.6 Mathematics: G.2, G.3, G.5, G.6, G.7, G.8, G.14, AII.10, MA.7, MA.8, PS.1*
56	Identify scientific laws and principles that are applicable to technology.	English: 10.4, 11.5, 12.5 History and Social Science: WHII.4 Science: PH.4, PH.6, PH.7
57	Propose a technology transfer.	English: 10.4, 11.5, 12.5
58	Model a proposed technology transfer using engineering techniques and processes.	English: 10.4, 11.5, 12.5

59	Diagram the material flow through the supply chain.	
60	Modify a quality assurance plan.	English: 10.2, 10.4, 10.8, 11.1, 11.5, 11.8 Mathematics: AFDA.8, PS.8*, PS.9*, PS.10*
61	Identify tools, machines, materials, and processes needed for a proposed technology transfer.	English: 10.4, 11.5, 12.5
62	Identify safety considerations specific to a proposed technology transfer.	English: 10.4, 11.5, 12.5
63	Evaluate a proposed technology transfer.	English: 10.4, 11.5, 12.5
64	Organize an engineering design project team.	English: 10.2, 10.8, 11.1, 11.5, 12.1, 12.5
65	Use team feedback to improve technological systems.	English: 10.2, 10.4, 11.1, 11.5, 12.1, 12.5
66	Resolve conflict within a team.	English: 10.2, 11.1, 12.1
67	Employ active-listening techniques in an engineering team.	English: 10.2, 11.1, 12.1
68	Explain the benefits of active listening.	English: 10.4, 11.5, 12.5
69	Explain the benefits of multiple perspectives and diverse skills in solving real-world problems.	English: 10.4, 11.5, 12.5
70	Evaluate the team process.	English: 10.4, 11.5, 12.5
71	Perform responsibilities as defined by serving on a design engineering team.	English: 10.4, 11.5, 12.5
72	Transfer a technology system, process, or artifact to solve a problem.	English: 10.6, 10.7, 11.6, 11.7, 12.6, 12.7
73	Present a technology transfer solution as a team.	English: 10.4, 11.5, 12.5
74	Evaluate the effectiveness of group dynamics.	English: 10.2, 10.4, 11.1, 11.5, 12.1, 12.5

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
- 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.*

- Technology Assessment (8406/18 weeks)
- Technology Assessment (8407/36 weeks)
- Technology Foundations (8402/18 weeks)
- Technology Foundations (8403/36 weeks)

Career Cluster: Manufacturing	
Pathway	**Occupations**
Health, Safety, and Environmental Assurance	Occupational Health and Safety Specialist Safety Engineer
Logistics and Inventory Control	Logistician
Manufacturing Production Process Development	Electro-Mechanical Technician Industrial Engineer Industrial Engineering Technician Manufacturing Systems Engineer Network Designer Precision Inspector, Tester, or Grader Production Manager Programmer SPC (Statistical Process Control) Coordinator
Production	Assembler Automated Manufacturing Technician Extruding and Drawing Machine Operator

Career Cluster: Manufacturing	
Pathway	**Occupations**
	Tool and Die Maker
Quality Assurance	Precision Inspector, Tester, or Grader Quality Control Technician

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Engineering and Technology	Aeronautical Drafter Aerospace Engineer Aerospace Engineering Technician Architect Civil Engineer Civil Engineering Technician Commercial and Industrial Designer Computer Hardware Engineer Electrical Engineer Electrical Engineering Technician Electro-Mechanical Technician Electronics Engineering Technician Engineering Manager Industrial Engineer Industrial Engineering Technician Machine Setter, Operator Manufacturing Systems Engineer Materials Engineer Mechanical Engineer Mechanical Engineering Technician Power Systems Engineer Project Manager Quality Engineer Quality Technician Statistician Systems Analyst
Science and Mathematics	Ecologist Materials Scientist Oceanographer Research Chemist Technical Writer