

# Sustainability and Renewable Technologies

8414 36 weeks

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## Course Description

**Suggested Grade Level:** 9 or 10 or 11 or 12

Sustainability and Renewable Technologies explores issues that affect global citizens in the areas of economics, culture, and the environment. The course introduces students to the historic, economic, political, environmental, and cultural issues that impact the global community and its future. Students will address issues affecting the health of the environment and explore solutions offered by sustainable agriculture, energy efficient building design, and renewable energy sources.

# 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	8414	Tasks/Competencies
Introducing Sustainability and Renewable Resources		
39	⊕	Interpret sustainability as it applies to social, economic, and environmental issues.
40	⊕	Illustrate the interconnectedness of the global community.
41	⊕	Compare and contrast renewable resources and non-renewable resources.
42	⊕	Develop a working glossary of terms related to sustainability and renewable technologies.
43	⊕	Evaluate a variety of media and informational sources for reliability, bias, and propaganda.
44	⊕	Analyze an individual's impact on natural resources.
45	⊕	Calculate an individual's carbon footprint, ecological footprint, and water footprint.
46	⊕	Implement practices to reduce personal carbon footprint.
Examining Social Sustainability		
47	⊕	Research quality-of-life issues in developed and developing countries.
48	⊕	Compare and contrast quality of life in developing nations with quality of life in developed nations.
49	⊕	Research the relationships among standard of living, economic growth, and energy consumption.
Exploring the Economics of Sustainability		
50	⊕	Differentiate between needs and wants.

51	⊕	Illustrate the interconnectedness of needs and wants and resource availability.
52	⊕	Identify factors that influence consumer choices.
53	⊕	Explain economic interests as a motivating force behind energy usage decisions.
54	⊕	Investigate the role of government and budgetary allocation in providing access to and distribution of resources.
55	⊕	Perform a life-cycle cost analysis.
Analyzing Environmental Issues		
56	⊕	Analyze the relationship between population and carrying capacity.
57	⊕	Research a country's gross domestic product (GDP) and its correlation to resource consumption.
58	⊕	Examine the environmental impacts of the extraction and reliance on fossil fuels.
59	⊕	Outline a major environmental issue that affects human health and the viability of our planet.
60	⊕	Demonstrate a major technological environmental issue's effect on global and local human health and the viability of our planet.
61	⊕	Debate strategies for responding to major environmental issues.
62	⊕	Explain basic concepts of ecology and environmental science.
63	⊕	Examine the interconnectedness between man-made structures and the natural environment.
Examining Technology's Impact on the Environment and Natural Resources		
64	⊕	Examine definitions of climate change.
65	⊕	Examine the scientific research regarding climate change.
66	⊕	Research how climate change will impact different regions of the United States.
67	⊕	Examine the economic impacts of climate change.

68	⊕	Research the impact of mankind's use of technology on the environment.
Evaluating Sustainable Practices		
69	⊕	Compare sustainable alternatives in agriculture.
70	⊕	Identify sustainable alternatives in construction and building management.
71	⊕	Explain the environmental impact of new construction versus renovation.
72	⊕	Design methods to reduce energy consumption in a given process in building management.
73	⊕	Research how effects from climate change can be mitigated.
74	⊕	Analyze linear and cyclical approaches to life cycles of common technological products.
75	⊕	Create a new product from existing products using the cradle-to-cradle approach.
Examining Renewable Energy		
76	⊕	Explain different energy technologies and their capacity to meet the social, economic, and environmental needs for a sustainable future.
77	⊕	Predict the ability of renewable and nonrenewable energy resources to meet future demand.
78	⊕	Analyze barriers to implementation of renewable technology and practices.
79	⊕	Propose methods of overcoming barriers to implementation of renewable technology and practices.
80	⊕	Assess the accessibility of renewable technologies within a given geographical area.
81	⊕	Measure energy output of a renewable energy source using proper instruments.
82	⊕	Explain the function of the basic components of a photovoltaic system.
83	⊕	Produce a working wind turbine.

84	⊕	Investigate the effects of light intensity and color on the energy output of a photovoltaic (PV) array.
85	⊕	Construct a model of a photovoltaic (PV) array and/or wind turbine system that powers a small device.
86	⊕	Investigate how wind speed and direction affect wind turbine energy output.
87	⊕	Explain the basic principles of geothermal and geo-exchange systems.
88	⊕	Compare and contrast sustainable alternatives and conventional building practices.

Legend: ⊕ Essential ○ Non-essential ⊖ Omitted

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## Curriculum Framework

### Introducing Sustainability and Renewable Resources

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#### Task Number 39

**Interpret sustainability as it applies to social, economic, and environmental issues.**

##### Definition

Interpretation should include defining *sustainability* as it relates to cultural and personal philosophies, government policies and business practices, and the environment and natural resources.

##### Process/Skill Questions

- For a word that can have many permutations, what is the simplest way to define *sustainability*?

- What conditions (e.g., economic climate; desire for status symbols; lack of interest, knowledge, or understanding) can be blamed for society's reluctance to practice sustainability?
- How might one's awareness of sustainability in one aspect of life (e.g., energy consumption) lead to practicing sustainability in other areas (e.g., landscaping)?
- How can intangibles, such as compromised natural resources and impact to future generations, be valued so that economic comparisons can be made to determine the value of investing in sustainability?
- Explain how sustainability could be achieved differently in the first world versus the third world. Which is more sustainable right now?

## **ITEEA National Standards**

**13. Assess the Impact of Products and Systems**

**15. Agricultural and Related Biotechnologies**

**16. Energy and Power Technologies**

**17. Information and Communication Technologies**

**19. Manufacturing Technologies**

**20. Construction Technologies**

**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**

**Debating Technological Issues**

**Essays on Technology**

**Extemporaneous Speech**

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## **Task Number 40**

**Illustrate the interconnectedness of the global community.**

## **Definition**

Illustration should employ a systems-thinking approach to demonstrate the relationships (i.e., economic, political, and social) that exist at multiple levels (local, national, international) throughout the world. Illustration should consider that consumerism is driving the global interconnectedness.

## **Process/Skill Questions**

- How would you explain a systems-thinking approach?
- How does the sale of t-shirts made from cotton grown in the midwestern U.S. impact the physical health of persons living in the region?
- When a consumer chooses a product manufactured in a developing country, and the choice is made solely because of the product's lower price, what effect might that decision have?
- What is meant by "fair trade," and what are its implications?
- What is meant by the "new global economy"?
- How are conflicts in the Middle East and growth of a middle class in Asia affecting the price of gas in the United States?
- How can a disaster in one area of the world affect other areas of the world economically?

## **ITEEA National Standards**

### **13. Assess the Impact of Products and Systems**

### **17. Information and Communication Technologies**

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

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

## **TSA Competitive Events**

### **Digital Video Production**

### **Geospatial Technology (Virginia only)**

### **Scientific Visualization (SciVis)**

### **Webmaster**

## **Task Number 41**

### **Compare and contrast renewable resources and non-renewable resources.**

#### **Definition**

Comparison/contrast should include defining *renewable resources* and *non-renewable resources* and distinguishing between examples of resources and the long-term/short-term benefits and true (or full) cost. Definitions should clearly describe the terms, illustrate the differences, and provide examples of each.

Some examples of renewable resources are sunlight, water, and wood. Non-renewable resources include fossil fuels, such as oil, natural gas, and coal.

#### **Process/Skill Questions**

- Why are trees considered a renewable resource?
- What factors contribute to continued use of non-renewable resources?
- How might a life-cycle cost analysis be applied when purchasing an automobile?
- How do renewable and non-renewable energy sources compare with regards to pollution by-products, efficiency, and dollars invested per kilowatt hour?
- How have the non-renewable fossil fuels been beneficial to humans in the last century while at the same time causing problems that may linger beyond this century?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

##### **18. Transportation Technologies**

##### **19. Manufacturing Technologies**

##### **20. Construction Technologies**

##### **5. The Effects of Technology on the Environment**

#### **TSA Competitive Events**

##### **Essays on Technology**

##### **Extemporaneous Speech**

## Task Number 42

### **Develop a working glossary of terms related to sustainability and renewable technologies.**

#### **Definition**

Development should include defining unfamiliar terms as they are encountered throughout the course.

#### **Process/Skill Questions**

- How can one determine the reliability of a definition found online?
- What are some consequences of not understanding common vocabulary related to sustainability and renewable technologies?
- Why might different people in the same class have a varied list of terms with definitions that may vary?

#### **ITEEA National Standards**

##### **2. The Core Concepts of Technology**

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## Task Number 43

### **Evaluate a variety of media and informational sources for reliability, bias, and propaganda.**

#### **Definition**

Evaluation should include examining various messages and considering the source, the intended audience, and the purpose (e.g., to inform, to persuade). Citations and funding sources will help determine whether it is reliable or should be recognized as biased.

#### **Process/Skill Questions**

- Why should you be suspicious of an energy company's so-called environmentally-friendly initiatives?

- What should you consider when determining the reliability of research?
- What groups or resources exist for checking the veracity of media and informational sources (e.g., *Green Inc.* by Christine Catherine MacDonald)?
- What is "greenwashing"?
- Are any sources of information truly unbiased? Explain your answer.
- What are some standards for deciding the degree of bias in an information source?
- How do various news shows depict sustainability issues?
- Why are there differences when news channels report on the same issue?
- Who owns the major news channels and newspapers?

## **ITEEA National Standards**

### **17. Information and Communication Technologies**

#### **TSA Competitive Events**

##### **Debating Technological Issues**

##### **Essays on Technology**

##### **Extemporaneous Speech**

##### **Prepared Presentation**

## **Task Number 44**

### **Analyze an individual's impact on natural resources.**

#### **Definition**

Analysis should include considering data that measures an individual's contact with and consumption of natural resources in a given timeframe (e.g., day, week, lifetime). Impact may be driven by consumer choices, such as transportation, energy use, purchases, and leisure activities.

#### **Process/Skill Questions**

- What effects do motor-boating, tubing, and waterskiing in rivers and lakes have on the water, shoreline, and surrounding ecosystems?
- How does your consumption of meat products contribute to carbon dioxide levels in the atmosphere?
- When buying a new car, what are the personal, environmental, and economic considerations you would need to analyze?

- What is the monetary savings over 10 years between a car that gets 20 miles to the gallon and one that gets 35 miles to the gallon if you pay \$3.50 per gallon and drive 5200 miles per year? (\$4,000 savings over 10 years)
- What resources do you affect by riding a school bus (or driving a personal vehicle) five days a week? What resources would you affect riding a bicycle to school or work?
- In a given week what have you done that has an impact on the area's natural resources? Are those effects positive or negative? Explain.
- What effects do our decisions about waste disposal have on the availability and quality of natural resources?
- What steps can individuals take to reduce their consumption of natural resources?

## **ITEEA National Standards**

**13. Assess the Impact of Products and Systems**

**15. Agricultural and Related Biotechnologies**

**18. Transportation Technologies**

**5. The Effects of Technology on the Environment**

## **TSA Competitive Events**

**Debating Technological Issues**

**Essays on Technology**

**Extemporaneous Speech**

**Prepared Presentation**

## **Task Number 45**

### **Calculate an individual's carbon footprint, ecological footprint, and water footprint.**

#### **Definition**

Calculation should include recording an individual's daily activity in a journal and using mathematics to determine the amount of carbon emitted by an individual's activity over a given timeframe (e.g., day, week, lifetime).

## Process/Skill Questions

- What do you throw away over a one week period?
- How much does the amount of beef you eat contribute to your carbon footprint?
- What are the countries of origin for your food during one meal at home?
- What is the carbon footprint of a box of macaroni and cheese (or ramen noodles, pizza, Big Mac)? How did the food get to you?

Teacher resources:

- <http://www.myfootprint.org>
- <http://www.footprintnetwork.org>.

## ITEEA National Standards

**13. Assess the Impact of Products and Systems**

**15. Agricultural and Related Biotechnologies**

**18. Transportation Technologies**

**5. The Effects of Technology on the Environment**

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## Task Number 46

### Implement practices to reduce personal carbon footprint.

#### Definition

Implementation should include planning and initiating practices such as a recycling program, reduction of energy consumption, and change of consumer habits (in the classroom, school, home, or community).

#### Process/Skill Questions

- What immediate changes can you make in your daily life to reduce your personal carbon footprint?
- What other changes can you make to reduce your personal carbon footprint?
- How much CO<sub>2</sub> is emitted by producing a cheeseburger?
- What will be the easiest change in personal carbon footprint reduction? The most difficult? The most invisible?
- How does a person's carbon footprint change at different points during the year?

Teacher resources:

- [Water footprint network](#)
- [Water Footprint Calculator](#)
- [Measuring Water Use: Essential Answer](#)

## **ITEEA National Standards**

**13. Assess the Impact of Products and Systems**

**15. Agricultural and Related Biotechnologies**

**18. Transportation Technologies**

**5. The Effects of Technology on the Environment**

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# **Examining Social Sustainability**

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## **Task Number 47**

### **Research quality-of-life issues in developed and developing countries.**

#### **Definition**

Research should include those technological, health, environmental, and social issues that illustrate the marked difference between developed and developing countries that may include

- services
- resource use
- water quality and availability
- air quality
- policy
- transportation
- nutrition
- culture

- health
- education
- human rights.

### **Process/Skill Questions**

- What is the average day for a 15-year-old in a specified country?
- How does a family in the Republic of Congo cook their food?
- How is access to education in a developing country different from that in the United States?
- Why does air quality in China affect the air quality in Virginia?
- How can driving to the mall in the U.S. affect quality of life in Nigeria? In other countries?
- What are the big factors that a developing country must overcome in order to become a developed country?
- How does the quality of life compare in developing vs. developed countries?
- What are the economic drivers in developing vs. developed countries?
- Are there quality-of-life issues that are evident in developed countries that developing countries would do well to avoid? Explain.

### **ITEEA National Standards**

#### **13. Assess the Impact of Products and Systems**

#### **14. Medical Technologies**

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

### **TSA Competitive Events**

#### **Debating Technological Issues**

#### **Essays on Technology**

#### **Geospatial Technology (Virginia only)**

#### **Prepared Presentation**

## **Task Number 48**

# **Compare and contrast quality of life in developing nations with quality of life in developed nations.**

## **Definition**

Comparison/contrast should include

- examining a day in the life of an individual in a developing nation and one in a developed nation to discover the similarities and differences related to resource consumption and quality of life
- choosing an issue and examining differences from one culture to the next
- researching a quality-of-life issue in a developing nation and comparing/contrasting with the same issue in a developed nation.

## **Process/Skill Questions**

- What is “quality of life” in relation to culture, health, and human rights?
- Why is having choice key to experiencing quality of life?
- When measuring quality of life, what are some factors other than monetary wealth to consider?
- What are some alternatives to Gross National Product (GNP)? Consider [Genuine Progress Indicator \(GPI\)](#) and [Happy Planet Index](#).
- What are daily, weekly, and monthly choices you make that affect your quality of life? How are those choices different than the ones made by someone in a less developed country?

## **ITEEA National Standards**

### **13. Assess the Impact of Products and Systems**

### **14. Medical Technologies**

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

## **TSA Competitive Events**

### **Debating Technological Issues**

### **Essays on Technology**

### **Extemporaneous Speech**

### **Geospatial Technology (Virginia only)**

## Task Number 49

### Research the relationships among standard of living, economic growth, and energy consumption.

#### Definition

Research should include examining countries with various standards of living, their patterns of economic growth, and how their levels of energy consumption rise or fall in relation to these factors.

#### Process/Skill Questions

- How are *standard of living* and *economic growth* defined in both conventional and sustainable terms?
- What is the most important indicator of lower energy consumption in a given country?
- What relationships can be identified between energy consumption rates and infant mortality rates? Energy consumption and life expectancy? Energy consumption and obesity?
- How does the energy consumption of a developed country differ from that of a developing country?
- How are economic growth, standard of living, and energy consumption related?
- Can there be improved economic growth or standard of living while consuming less energy? Explain.
- What are some traditional drivers of economic growth?

#### ITEEA National Standards

##### 13. Assess the Impact of Products and Systems

##### 14. Medical Technologies

##### 16. Energy and Power Technologies

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

#### TSA Competitive Events

#### Debating Technological Issues

# Exploring the Economics of Sustainability

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## Task Number 50

### Differentiate between needs and wants.

#### Definition

Differentiation should identify needs as goods and services that a human being must have in order to survive, and wants as goods and services that, while perhaps desirable, are not necessary to survival. Food, water, shelter (safety), and energy are basic human needs. The ability to differentiate the two when making consumer decisions is invaluable when striving for sustainability.

#### Process/Skill Questions

- What are human needs at the most basic level?
- What are examples of human wants?
- How does an individual's ability to differentiate between needs and wants benefit society?
- How does one distinguish between a want and a need?
- Do needs and wants change according to where you live?
- Can one person's want be another person's need? Explain.

#### ITEEA National Standards

##### 2. The Core Concepts of Technology

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

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

## **TSA Competitive Events**

### **Essays on Technology**

### **Extemporaneous Speech**

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## **Task Number 51**

### **Illustrate the interconnectedness of needs and wants and resource availability.**

#### **Definition**

Illustration may include a diagram, written exposition, or performance that shows how consumerism (i.e., wants) impacts environmental, social, and economic systems. Illustration should reflect that when needs are satisfied, wants are magnified and resource consumption increases.

#### **Process/Skill Questions**

- What are some underlying issues with the consumer model for the current economy in the U.S.?
- During crisis situations, how might someone's wants and needs change?
- How does the satisfaction of human needs lead to a greater importance being placed on human wants?
- Should we judge which human wants should be satisfied from an ethical point of view? If so, how? If not, why not?
- How does availability of resources interconnect with human wants and needs?

#### **ITEEA National Standards**

##### **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**

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

## **TSA Competitive Events**

**Architectural Design**

**Engineering Design**

**Essays on Technology**

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## **Task Number 52**

### **Identify factors that influence consumer choices.**

#### **Definition**

Identification may include, but is not limited to

- consumer's world view, values, and awareness
- culture, marketing, and advertising
- economics
- availability
- access.

#### **Process/Skill Questions**

- What would make you happy?
- How do you define success?
- Would you be willing to pay more for a product if you knew it would last longer? Leave a smaller carbon footprint? Explain your answer.
- When thinking about buying a product, what factors influence your decision?
- What primary factors do you think influence consumers when purchasing products?

#### **ITEEA National Standards**

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

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

## **TSA Competitive Events**

**Essays on Technology**

**Extemporaneous Speech**

## **Task Number 53**

### **Explain economic interests as a motivating force behind energy usage decisions.**

#### **Definition**

Explanation should include the role financial concerns play in individuals', businesses', and organizations' decisions to operate in a more energy-efficient manner.

#### **Process/Skill Questions**

- How can changes in energy-consumption behaviors be motivated by the bottom line?
- Does reduction in energy consumption require a reduction in comfort or safety? Explain.
- How do energy conservation strategies boost the economic performance of companies?
- Which companies or organizations are models of efficient energy consumption?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

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

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

#### **TSA Competitive Events**

##### **Debating Technological Issues**

##### **Essays on Technology**

##### **Extemporaneous Speech**

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## **Task Number 54**

# **Investigate the role of government and budgetary allocation in providing access to and distribution of resources.**

## **Definition**

Investigation should examine local and federal laws and regulations that define industries' and citizens' access to resources, such as water, solar, wind, and clean air. Investigation should take into consideration that budgetary allocation (subsidies, grants, rebates, tax incentives) influences research and implementation of renewable technologies and sustainable practices.

## **Process/Skill Questions**

- How does the political importance of the Iowa presidential caucuses influence agricultural policy?
- How does the political process influence allocation of resources?
- What are some legislative issues regarding access to solar and wind resources in urban and in rural areas? In what ways are urban issues alike and different from rural issues?
- What actions should a citizen take if they do not approve of budgetary allocations and distribution of resources by government?
- How can someone with a significant idea for an energy-saving product or service obtain financing from government agencies?
- What are potential drawbacks of subsidies, grants, rebates, and tax incentives?

## **ITEEA National Standards**

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

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## **Task Number 55**

### **Perform a life-cycle cost analysis.**

#### **Definition**

Performance should include the costs of a system or a component over its entire life span. Typical costs for a system may include

- acquisition costs (or design and development costs)
- transportation costs
- operating costs, such as
  - cost of failures
  - cost of repairs
  - cost for spares

- downtime costs
- loss of production
- disposal costs.

A complete life cycle cost (LCC) analysis may also include other costs, as well as other accounting/financial elements (such as discount rates, interest rates, depreciation, and present value of money).

### **Process/Skill Questions**

- What are the considerations of true cost to include in a life-cycle cost analysis?
- What is a life-cycle cost analysis, and how can it inform consumer decision making?
- At what point during the cycle is system or product most expensive?
- Does the initial price of an object affect the life-cycle price?
- On what elements of a product's cost do consumers traditionally focus? What elements of a product's cost do consumers traditionally ignore?

### **ITEEA National Standards**

#### **19. Manufacturing Technologies**

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## **Analyzing Environmental Issues**

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### **Task Number 56**

#### **Analyze the relationship between population and carrying capacity.**

##### **Definition**

Analysis should include use of human and non-human examples of populations to determine the capacity of an area and the environmental consequences of exceeding the local environment's carrying capacity.

##### **Process/Skill Questions**

- How are population size and carrying capacity related to sustainability?

- What factors affect population growth in developing and in developed countries?
- When a population has exceeded its location's carrying capacity, what are the environmental consequences?
- How are population growth rates different in developed and developing countries?
- What are the implications for water, food, and resources availability over the next 10, 20, 30, 40, 50 years, given the data on population growth?
- What are significant issues relating to population control as they pertain to carrying capacity?
- How does carrying capacity vary around the world and with climate?

## **ITEEA National Standards**

### **5. The Effects of Technology on the Environment**

#### **TSA Competitive Events**

##### **Geospatial Technology (Virginia only)**

## **Task Number 57**

### **Research a country's gross domestic product (GDP) and its correlation to resource consumption.**

#### **Definition**

Research should include defining *gross domestic product* and investigating how the size of a country's GDP relates to its use of resources. Research should lead to a prediction about that relationship.

#### **Process/Skill Questions**

- What alternatives are there for measuring the progress of a country other than the GDP?
- What is GDP?
- How does a country's GDP affect population levels and the level of resource consumption per capita?
- How does the GDP of various less-developed African countries compare to that of the United States and European Union (EU) nations?
- What would be the impact if China were to employ the same economic and consumer habits as the United States?
- How has a country's (e.g., India) GDP changed over time in comparison to its population?

- What would need to change before our consumer habits would fit a sustainable model?
- What are the shortcomings of GDP as a measure of the sustainability of a country?
- What alternatives are there for measuring the progress of a country other than the GDP?

## **ITEEA National Standards**

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

## **TSA Competitive Events**

### **Geospatial Technology (Virginia only)**

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## **Task Number 58**

### **Examine the environmental impacts of the extraction and reliance on fossil fuels.**

#### **Definition**

Examination should include specific man-made disasters that have resulted from our use of fossil fuels. Examples of disasters that may be examined include the 2010 BP *Deepwater Horizon* oil leak in the Gulf of Mexico and the 1989 Exxon *Valdez* oil spill in Alaska.

Examination should also include the relationship between climate change and the potential for worsening natural disasters, such as droughts, forest fires, and hurricanes.

#### **Process/Skill Questions**

- What impacts do man-made disasters have on society?
- How could climate change worsen the impacts of natural disasters? Can man-made disasters ever be fully mitigated? What are the costs of mitigation vs. protection?
- What are the potential costs of climate change vs. the costs of switching to alternative energy sources?

## **ITEEA National Standards**

### **5. The Effects of Technology on the Environment**

### **7. The Influence of Technology on History**

## **TSA Competitive Events**

### **Debating Technological Issues**

### **Geospatial Technology (Virginia only)**

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## **Task Number 59**

### **Outline a major environmental issue that affects human health and the viability of our planet.**

#### **Definition**

Outline should provide an overview of the causes and threats of major environmental issues including, but not limited to,

- land use
- landscape alteration
- biodiversity
- air and water pollution
- resource depletion
- deforestation
- condition of fisheries
- water scarcity
- food supply.

#### **Process/Skill Questions**

- What are the root causes of this environmental issue?
- How does this environmental issue impact the sustainability of the planet?
- How does this environmental issue relate to other environmental issues?

#### **ITEEA National Standards**

#### **5. The Effects of Technology on the Environment**

## **TSA Competitive Events**

### **Essays on Technology**

### **Geospatial Technology (Virginia only)**

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## **Task Number 60**

**Demonstrate a major technological environmental issue's effect on global and local human health and the viability of our planet.**

### **Definition**

Demonstration should recreate an environmental issue (e.g., water contamination, deforestation) through the use of a model or presentation.

### **Process/Skill Questions**

- What are some examples of water and air pollutants in a given region or country?
- How has deforestation been linked to desertification around the world?
- How does smog affect the health of citizens living in places like Los Angeles and Beijing?
- What effects do environmental issues have on human health?
- What effects do environmental issues have on natural resources that we require for survival?
- What effects do environmental issues have on ecosystems and their associated biological populations?

### **ITEEA National Standards**

**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**

**Geospatial Technology (Virginia only)**

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## **Task Number 61**

# **Debate strategies for responding to major environmental issues.**

## **Definition**

Debate should determine the practicality and likely success of various strategies for solving major environmental issues such as, but not limited to,

- climate change
- energy production/consumption
- land use
- pollution
- deforestation
- condition of fisheries
- water scarcity
- food supply.

## **Process/Skill Questions**

- What strategies are being employed to address greenhouse gas emissions?
- How does the global community approach policy for addressing environmental issues?
- What are some potential solutions to major environmental issues?
- What advantages and disadvantages do each of the potential solutions entail?

## **ITEEA National Standards**

### **5. The Effects of Technology on the Environment**

## **TSA Competitive Events**

### **Debating Technological Issues**

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## **Task Number 62**

### **Explain basic concepts of ecology and environmental science.**

#### **Definition**

Explanation should include describing the concepts and identifying their significance with regard to sustainability.

## **Process/Skill Questions**

- What did Chief Seattle mean when he said in 1854, "The Earth does not belong to us. We belong to the Earth"?
- What are the basic concepts of ecology?
- What are the basic concepts of environmental science?
- In what ways can these concepts be used in the argument for sustainability?

## **ITEEA National Standards**

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

### **7. The Influence of Technology on History**

## **TSA Competitive Events**

### **Biotechnology Design**

### **Debating Technological Issues**

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## **Task Number 63**

### **Examine the interconnectedness between man-made structures and the natural environment.**

#### **Definition**

Examination should include exploring the relationships between man-made structures (e.g., transportation infrastructure, buildings) and the natural environment. Exploration should also include studying methods for lessening the impact structures have on the environment.

#### **Process/Skill Questions**

- How does a building impact water, habitat, and temperature in an urban area?
- How do hardscape surfaces impact groundwater recharge?
- How does building a new bridge alter the surrounding natural environment?
- When a new dam is constructed, what changes occur to the water flow and patterns?
- In what ways do man-made structures interact with the natural environment?
- When structures are built, how is the land on the site affected?
- When structures are built, how is the albedo (reflecting power) of the ground affected?

## **ITEEA National Standards**

**13. Assess the Impact of Products and Systems**

**20. Construction Technologies**

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

**9. Engineering Design**

## **TSA Competitive Events**

**Architectural Design**

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# **Examining Technology's Impact on the Environment and Natural Resources**

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## **Task Number 64**

### **Examine definitions of climate change.**

#### **Definition**

Examination should include definitions from reputable national and international organizations for global warming and climate change, such as

- [NASA: Climate Change](#)
- [Intergovernmental Panel on Climate Change \(IPCC\)](#)
- [International Institute for Sustainable Development \(IISD\)](#)
- [CARE Climate Change Information Center](#)
- [United Nations Sustainable Development Goal.](#)

#### **Process/Skill Questions**

- What do you think climate change means?

- What do people say about climate change?
- What is an example of climate change?

## **ITEEA National Standards**

### **5. The Effects of Technology on the Environment**

#### **TSA Competitive Events**

##### **Essays on Technology**

##### **Extemporaneous Speech**

##### **Prepared Presentation**

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## **Task Number 65**

### **Examine the scientific research regarding climate change.**

#### **Definition**

Examination should include research by non-biased and reputable scientific communities about climate change issues, such as

- carbon dioxide and other greenhouse gas variations
- human activity and greenhouse gas
- factors that drive global warming
- how global warming impacts climate
- population growth
- energy production
- agricultural practices (e.g., tillage, concentrated animal feeding operations [CAFO]).

#### **Process/Skill Questions**

- In what ways do climate change and global warming differ? How are climate change and global warming related?
- Who are the parties that debate global warming?
- What are the implications for business if global warming and climate change become a prominent issue in government policy?
- What are the contrasting views on the science behind man-made climate change?

## **ITEEA National Standards**

## **5. The Effects of Technology on the Environment**

### **TSA Competitive Events**

#### **Debating Technological Issues**

#### **Essays on Technology**

#### **Extemporaneous Speech**

#### **Geospatial Technology (Virginia only)**

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## **Task Number 66**

### **Research how climate change will impact different regions of the United States.**

#### **Definition**

Research should include regional analysis environmental, economic and social effects of climate change.

#### **Process/Skill Questions**

- What are the predicted impacts of drought and forest fires in the southwestern United States?
- How will increased rainfall and changes in rainfall patterns impact the midwestern United States?
- How will temperature changes impact the agricultural production of the southern United States?
- How will access to water create climate refugees in the United States?
- How will the rise in sea levels affect coastal industries and import/export businesses of the coastal United States?

### **TSA Competitive Events**

#### **Essays on Technology**

#### **Extemporaneous Speech**

#### **Prepared Presentation**

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## **Task Number 67**

### **Examine the economic impacts of climate change.**

#### **Definition**

Examination should include impacts on

- healthcare
- natural resource production
- agriculture viability
- access to food and energy
- tourism income and industries
- habitability of a given region or area.

#### **Process/Skill Questions**

- How will climate change create growing health challenges for the elderly and young children?
- How will cost of treating respiratory illnesses change over the next 20, 50 and 75 years due to changing climate?
- How will diseases such as Lyme disease change due to climate change?

#### **ITEEA National Standards**

##### **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**

##### **Geospatial Technology (Virginia only)**

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## **Task Number 68**

### **Research the impact of mankind's use of technology on the environment.**

#### **Definition**

Research should include the harmful effects of conventional practices in manufacturing, agriculture, construction, energy production, land-use patterns, and transportation; the reasons they are perpetuated; and alternatives that lessen the impact on the environment.

#### **Process/Skill Questions**

- What is sprawl, and how does it impact the environment? What methods of development are preferable to sprawl?
- Clean water and clean air have value, while oil has a price; which is more important, value or price? Explain.
- How would you elaborate on the difference between value and price?
- Why is it in the best interest of conventional businesses/industries/organizations to consider value vs. price when operating?
- What major corporations are changing environmentally damaging patterns to practices that respect the land, resources, and peoples with whom they do business? In what ways and for what reasons are they doing so?

#### **ITEEA National Standards**

##### **5. The Effects of Technology on the Environment**

#### **TSA Competitive Events**

##### **Essays on Technology**

##### **Extemporaneous Speech**

##### **Prepared Presentation**

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## **Evaluating Sustainable Practices**

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## **Task Number 69**

### **Compare sustainable alternatives in agriculture.**

#### **Definition**

Comparison should cover the latest trends in sustainable agriculture to include equipment and growing methods.

#### **Process/Skill Questions**

- What are some well-regarded resources for exploring sustainable alternatives in agriculture?
- What are some differences between sustainable farming and organic farming?
- What does it mean when a farm product is Certified Naturally Grown?
- How do methods for weed and pest control differ between conventional farming and sustainable closed-system farming?
- What are some best practices in sustainable agriculture?
- Why should aquaculture, hydroponics, and aquaponics be considered when looking at sustainable alternatives in agriculture?
- What are the pros and cons of aquaculture, hydroponics, and aquaponics?
- What are some alternative ways of using chemical fertilizers to alter soil composition?
- What are cover crops, nitrogen fixers, and rotational grazing?
- How can techniques of smaller sustainable farming, such as permaculture, be integrated into industrial scale farming? How might these techniques affect a farmer's bottom line?

#### **ITEEA National Standards**

##### **15. Agricultural and Related Biotechnologies**

#### **TSA Competitive Events**

##### **Biotechnology Design**

##### **Geospatial Technology (Virginia only)**

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## **Task Number 70**

# **Identify sustainable alternatives in construction and building management.**

## **Definition**

Identification should include the latest trends in sustainable construction and building management. The value of an alternative approach is made clear when “total cost of ownership” is calculated.

Identification should also include green building accreditation models such as Leadership in Energy and Environmental Design (LEED) and Earthcraft.

## **Process/Skill Questions**

- Who are the stakeholders and how does that affect the decision to commit to green building?
- What are some well-regarded resources for exploring sustainable alternatives in construction and building management?
- What is meant by “total cost of ownership”?
- How do best-management practices in site selection and stormwater management differ between conventional designs and green building designs?
- Why is it economical to build according to LEED standards?
- What effect does the indoor environmental quality of green buildings have on productivity?
- How do state and government regulations play a role in the implementation of green buildings?

## **ITEEA National Standards**

### **20. Construction Technologies**

#### **9. Engineering Design**

## **TSA Competitive Events**

### **Architectural Design**

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## **Task Number 71**

## **Explain the environmental impact of new construction versus renovation.**

### **Definition**

Explanation should include determining whether, from a social, environmental, and economic standpoint, new construction should be favored over renovation of an existing structure.

### **Process/Skill Questions**

- Is new construction always a better green choice than the renovation of an existing structure? Explain.
- What are the environmental and financial benefits to be gained in renovation?
- What are the environmental and financial benefits to be gained in new construction?
- How should one decide whether to renovate or build new?
- How are decisions influenced where historic buildings, blighted buildings, and [brownfields](#) are concerned?

### **ITEEA National Standards**

#### **20. Construction Technologies**

##### **5. The Effects of Technology on the Environment**

##### **9. Engineering Design**

### **TSA Competitive Events**

#### **Geospatial Technology (Virginia only)**

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## **Task Number 72**

### **Design methods to reduce energy consumption in a given process in building management.**

#### **Definition**

Designing should include a targeted project that uses quantifiable metrics and outcomes.

#### **Process/Skill Questions**

- How does occupant behavior affect energy consumption in your school?
- What is required of a person to reduce the energy needs in the home?
- How can changing lifestyle affect energy consumption?
- What methods can be used to reduce energy consumption while providing services?
- How can you measure the energy use pre-test and post-test?
- How can you use current energy consumption data to design an effective and efficient dwelling?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

#### **9. Engineering Design**

## **TSA Competitive Events**

### **Architectural Design**

### **Geospatial Technology (Virginia only)**

## **Task Number 73**

### **Research how effects from climate change can be mitigated.**

#### **Definition**

Research should include modifications in

- agricultural practices
- energy production
- city and town planning and zoning
- resource management
- infrastructure design and engineering.

#### **Process/Skill Questions**

- How can changing conventional agricultural practices to sustainable practices help sequester carbon?
- How can use of solar and wind energy help reduce carbon emissions?
- How can better zoning and planning help provide habitat and water table recharge?
- How can green building design help reduce stormwater management stresses in urban landscapes?

- How can sustainable forestry management help improve wildlife, soil, and CO<sub>2</sub> reduction?
- How do green buildings impact air quality and energy demand?

Teacher resource:

- [United Nation's Sustainable Development Goals](#)

## **ITEEA National Standards**

### **5. The Effects of Technology on the Environment**

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## **Task Number 74**

### **Analyze linear and cyclical approaches to life cycles of common technological products.**

#### **Definition**

Analysis should include describing linear (cradle-to-grave) and cyclical (cradle-to-cradle) lifelines of products and materials. A linear approach considers the product or material from the time of acquisition to disposal. A cyclical approach considers the product or material from the time of its acquisition to its being reused, remanufactured, and/or recycled.

Examples of products to analyze may include oil, water, soil, compost, biological waste, cell phones, tennis shoes, tires, hamburgers, and refrigerators.

#### **Process/Skill Questions**

- How does the cradle-to-grave approach handle the end-of-life stage of a product?
- How does the cradle-to-cradle approach change the cradle-to-grave approach?
- What are the environmental benefits of a cradle-to-cradle product life-cycle?
- What is remanufacturing?
- How can a given product be redesigned to become reusable?
- Why is it important to think about a product's life cycle?
- What is more economically efficient for a business, a linear or cyclical approach?

Teacher resource:

- [Cradle-to-Cradle Products Innovation Institute](#)

## **ITEEA National Standards**

## **12. Use and Maintain Technological Products and Systems**

## **13. Assess the Impact of Products and Systems**

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### **Task Number 75**

## **Create a new product from existing products using the cradle-to-cradle approach.**

### **Definition**

Creation should include reclaiming material and parts from two or more existing products and using them to remanufacture a new product.

### **Process/Skill Questions**

- What benefits does the cradle-to-cradle approach confer on the consumer and the product developers?
- How can a new product be made from a discarded product?
- Why is it important to look at existing products and their parts when creating new products?
- What is an example of a new product made from multiple existing products? Why is this something to consider when creating a new product?

### **ITEEA National Standards**

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

## **9. Engineering Design**

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# **Examining Renewable Energy**

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### **Task Number 76**

# **Explain different energy technologies and their capacity to meet the social, economic, and environmental needs for a sustainable future.**

## **Definition**

Explanation should include the function and efficiency of wind, solar, geothermal, and other regionally applicable technologies.

## **Process/Skill Questions**

- What is the cost per kilowatt hour for solar, wind, and conventional electricity production in your area?
- What renewable energy sources are most likely to be able to meet future energy needs in the U.S.?
- What are the available renewable energy sources?
- How much energy can each source provide to a larger energy system?
- What are the costs associated with renewable technologies?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

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## **Task Number 77**

# **Predict the ability of renewable and nonrenewable energy resources to meet future demand.**

## **Definition**

Predictions should include determining the amount of energy currently produced by renewable resources and nonrenewable resources and their ability to sustain future demand.

Examples of renewable resources include wind, water, biomass, solar, and geothermal. Examples of nonrenewable resources include oil/petroleum, natural gas, coal, and uranium (nuclear).

## **Process/Skill Questions**

- What is meant when indigenous peoples say, “We must protect the Earth for seven generations to come”?

- What are the federal government’s goals for renewable energy production in the U.S. over the next 35–50 years?
- What are state incentives for installation of renewable technologies?
- What are the advantages and disadvantages of renewable and non-renewable energy resources?
- How will demand for energy change in the future?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

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## **Task Number 78**

### **Analyze barriers to implementation of renewable technology and practices.**

#### **Definition**

Analysis should lead to identification of the most successful methods of renewable technology and practices. Barriers include

- governmental policy
- existing and needed infrastructure
- workforce training and retraining
- education and public awareness
- technological barriers, such as energy storage.

#### **Process/Skill Questions**

- What are the projected workforce needs for providing installation and adaptation of renewable technologies for the next 10 years?
- Would your parents install a renewable energy product in your home? Why, or why not?
- What are the barriers to placing a wind energy farm off the coast of Virginia or in the mountains? Why are these barriers in place?
- What are the obstacles that must be overcome to offer renewable energy sources to the public?
- What are ways to inform the public about actions they can personally take to implement sustainable practices?
- How can employers and government agencies implement renewable technologies and sustainable practices on a large scale?
- What renewable technologies or processes should be targeted for early adoption?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

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

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

## **TSA Competitive Events**

### **Debating Technological Issues**

### **Essays on Technology**

### **Extemporaneous Speech**

### **Geospatial Technology (Virginia only)**

### **Prepared Presentation**

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## **Task Number 79**

### **Propose methods of overcoming barriers to implementation of renewable technology and practices.**

#### **Definition**

Proposal should include strategies that address

- governmental policy
- existing and needed infrastructure
- workforce training and retraining
- education and public awareness.

#### **Process/Skill Questions**

- How can the consumer be educated about the true cost of renewable technology and the benefits of energy efficiency?
- How are renewable technologies and government policy intertwined?
- What strategies can be implemented to remove obstacles so renewable energy sources can be used?

- What can individuals do to help implement renewable energy sources?

Teacher resource:

- [North American Board of Certified Energy Practitioners](#) (NABCEP)

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

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

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

## **TSA Competitive Events**

### **Essays on Technology**

### **Extemporaneous Speech**

### **Geospatial Technology (Virginia only)**

### **Prepared Presentation**

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## **Task Number 80**

### **Assess the accessibility of renewable technologies within a given geographical area.**

#### **Definition**

Assessment should include the use of appropriate data (e.g., climate, solar energy index, wind energy index, geographic information systems) to determine appropriate application of specific technologies.

#### **Process/Skill Questions**

- What is the most economical renewable energy source for your area?
- What factors should be considered in locating a wind turbine? In locating solar arrays?
- What socioeconomic factors should be considered when building a wind turbine or installing solar arrays?

- How can production of energy from biomass be economically viable?

Teacher resource:

- [PVWatts Calculator](#)

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

#### **Geospatial Technology (Virginia only)**

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## **Task Number 81**

### **Measure energy output of a renewable energy source using proper instruments.**

#### **Definition**

Measurement should include use of a multimeter to determine energy output of sources such as

- photovoltaic array
- wind turbine
- fuel cell.

#### **Process/Skill Questions**

- What is the most energy efficient renewable energy source? Why?
- How has the efficiency of renewable energy sources changed over time?
- How is it possible to determine the electrical load of a device to be powered?
- Why is the output of a device variable?
- How are voltage, current, and resistance measured with a multimeter?
- What measurements can determine the efficiency or level of performance of a fuel cell, a photovoltaic array, or a wind turbine?
- What variables should be controlled when making measurements on energy transforming systems?

## **ITEEA National Standards**

## **12. Use and Maintain Technological Products and Systems**

### **16. Energy and Power Technologies**

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## **Task Number 82**

### **Explain the function of the basic components of a photovoltaic system.**

#### **Definition**

Explanation should include

- inverter
- cell module
- array
- mounting devices
- battery
- battery charge controller
- load.

#### **Process/Skill Questions**

- What is a grid-tie solar electric system?
- How do the components of the system work together to get electricity to your home?
- What is the purpose of an inverter?
- Why is a battery charge controller needed on some systems?
- What is the difference between an array and a cell module?
- How do the components of a photovoltaic system interact to produce usable power?
- Which components are involved in the basic energy transformation that makes the device function?
- How do each of the components contribute to the efficient function of the system?

#### **ITEEA National Standards**

### **12. Use and Maintain Technological Products and Systems**

### **16. Energy and Power Technologies**

### **2. The Core Concepts of Technology**

### **9. Engineering Design**

## **TSA Competitive Events**

### **Engineering Design**

### **Technology Bowl**

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## **Task Number 83**

### **Produce a working wind turbine.**

#### **Definition**

Production should include

- tower
- nacelle
- rotor
- generator
- shaft
- blades
- load.

#### **Process/Skill Questions**

- How does blade design affect energy output?
- What is the purpose of a nacelle?
- What can be changed about the blades that might make the turbine more efficient?
- Why does the generator not power the load by itself?
- How do the components of a wind turbine interact to produce usable power?
- Which components are involved in the basic energy transformation that makes the device function?
- How does each of the components contribute to the efficient function of the system?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

##### **9. Engineering Design**

## **TSA Competitive Events**

## **Task Number 84**

### **Investigate the effects of light intensity and color on the energy output of a photovoltaic (PV) array.**

#### **Definition**

Investigation should include using a multimeter, various light sources (natural and artificial), and the visible light spectrum.

#### **Process/Skill Questions**

- Would changing light color improve energy production in a PV system?
- Why do the light intensity and color affect the energy output of a PV array?
- What are the effects of different color filters on the output of photovoltaic cells?
- How does varying intensity affect the output of photovoltaic cells?
- What are the effects of different light sources on the output of photovoltaic cells?
- What is the difference between power and energy?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

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## **Task Number 85**

### **Construct a model of a photovoltaic (PV) array and/or wind turbine system that powers a small device.**

#### **Definition**

Construction should result in a PV and/or wind turbine system that produces electricity.

#### **Process/Skill Questions**

- What occurs when DC current is moved for long distances?

- What tools are needed to assemble the model safely?
- How can the engineering design process be applied to the development of turbine models?
- What troubleshooting steps might be taken if the load device does not work?
- What are the similarities and differences between a model PV and/or wind turbine system and the full-scale systems?
- How do the system's parts interact to produce usable power?
- What are the factors that affect the amount of power produced by the model?
- How do the factors that affect the model's output effect a full-scale system?

## **ITEEA National Standards**

### **11. Apply the Design Processes**

### **16. Energy and Power Technologies**

### **9. Engineering Design**

## **TSA Competitive Events**

### **Architectural Design**

## **Task Number 86**

### **Investigate how wind speed and direction affect wind turbine energy output.**

#### **Definition**

Investigation should include determining how wind speed and direction influence the amount of energy produced by a wind turbine.

#### **Process/Skill Questions**

- Would your school provide a good location for a wind turbine? Why?
- What might affect the amount of power generated, other than wind velocity?
- How is wind direction a factor in designing wind turbines?
- What are some tradeoffs to consider when determining the number of blades to be used?
- How do a variety of wind speeds affect the energy output of a wind turbine?
- How do a variety of wind directions affect the energy output of a wind turbine?

- Is there a desirable combination of wind speed and direction that optimize the ability of a wind turbine system to produce power?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

##### **Architectural Design**

##### **Geospatial Technology (Virginia only)**

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## **Task Number 87**

### **Explain the basic principles of geothermal and geo-exchange systems.**

#### **Definition**

Explanation should include differences between deep well geothermal and shallow trench designs.

#### **Process/Skill Questions**

- How does temperature change as related to depth in the earth's crust?
- How is water involved in deep-well geothermal energy production?
- What are some consequences of deep-well geothermal energy?
- What might be some advantages of shallow-trench designs for storing thermal energy?
- What energy source is being used in geothermal systems?
- How do deep-well and shallow-trench designs differ in both their design characteristics and their ability to produce energy?
- What are the advantages and disadvantages of deep-well and shallow-trench geothermal systems?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

#### **9. Engineering Design**

## **TSA Competitive Events**

**Principles of Technology (Virginia only)**

**Scientific Visualization (SciVis)**

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## **Task Number 88**

### **Compare and contrast sustainable alternatives and conventional building practices.**

#### **Definition**

Comparison/contrast should include

- site selection
- water efficiency
- energy and atmosphere
- materials and resources
- indoor environmental quality
- innovation in design
- regional priority.

#### **Process/Skill Questions**

- How does building orientation affect heating and cooling loads?
- What is important to consider when looking for sustainable alternatives in construction? Why are these important to consider, and do the factors change from one place to another?
- Why is gray water use part of sustainable design?
- What are the advantages and disadvantages of conventional building practices for developers, consumers, and the community at large?
- What are the advantages and disadvantages of sustainable building practices for developers, consumers, and the community at large?
- What factors affect the adoption or rejection of sustainable building practices?

#### **ITEEA National Standards**

##### **13. Assess the Impact of Products and Systems**

## **TSA Competitive Events**

**Architectural Design**

**Debating Technological Issues**

**Engineering Design**

**Essays on Technology**

**Geospatial Technology (Virginia only)**

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## **SOL Correlation by Task**

39	Interpret sustainability as it applies to social, economic, and environmental issues.	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5  History and Social Science: VUS.14
40	Illustrate the interconnectedness of the global community.	English: 9.1, 9.5, 10.1, 10.5, 11.1, 11.5, 12.1, 12.5  History and Social Science: GOVT.7, GOVT.8, GOVT.9, GOVT.15, WG.17, WG.18  Mathematics: DM.12
41	Compare and contrast renewable resources and non-renewable resources.	English: 9.3, 9.5, 10.3, 10.5, 11.3, 11.5, 12.3, 12.5  History and Social Science: WG.4  Science: ES.6
42	Develop a working glossary of terms related to sustainability and renewable technologies.	English: 9.3, 10.3, 11.3, 12.3
43	Evaluate a variety of media and informational sources for reliability, bias, and propaganda.	English: 9.2, 9.5, 10.2, 10.5, 11.2, 11.5, 12.2, 12.5  History and Social Science: GOVT.1, VUS.1  Mathematics: PS.9*
44	Analyze an individual's impact on natural resources.	English: 9.5, 10.5, 11.5, 12.5

		History and Social Science: VUS.13, VUS.14, WG.4, WHII.13, WHII.14  Mathematics: PS.5, PS.2*, PS.3*, PS.4*  Science: BIO.8, ES.6
45	Calculate an individual's carbon footprint, ecological footprint, and water footprint.	Mathematics: A.1, A.3  Science: BIO.1, BIO.8, ES.1, ES.7, ES.11
46	Implement practices to reduce personal carbon footprint.	History and Social Science: GOVT.9, GOVT.15, WG.1, WG.2, WG.3, WG.4
47	Research quality-of-life issues in developed and developing countries.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8  History and Social Science: VUS.13, VUS.14, WG.1, WG.14, WG.15, WG.16, WG.17, WG.18, WHII.13, WHII.14
48	Compare and contrast quality of life in developing nations with quality of life in developed nations.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: VUS.13, VUS.14, WG.1, WG.14, WG.15, WG.16, WG.17, WG.18, WHII.13, WHII.14
49	Research the relationships among standard of living, economic growth, and energy consumption.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8  History and Social Science: WG.1, WG.14, WG.15, WG.16, WG.17, WG.18  Mathematics: A.8, A.9
50	Differentiate between needs and wants.	English: 9.5, 10.5, 11.5, 12.5
51	Illustrate the interconnectedness of needs and wants and resource availability.	English: 9.1, 9.5, 9.6, 10.1, 10.5, 10.6, 11.1, 11.5, 11.6, 12.1, 12.5, 12.6  History and Social Science: VUS.14, WG.1, WG.14, WG.15, WG.16, WG.17, WG.18
52	Identify factors that influence consumer choices.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.12, GOVT.13, VUS.14
53	Explain economic interests as a motivating force behind energy usage decisions.	English: 9.5, 10.5, 11.5, 12.5

54	Investigate the role of government and budgetary allocation in providing access to and distribution of resources.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8  History and Social Science: GOVT.9, GOVT.12, GOVT.13, GOVT.15, WG.1, WG.14, WG.15, WG.16, WG.17, WG.18
55	Perform a life-cycle cost analysis.	English: 9.5, 10.5, 11.5, 12.5  Mathematics: A.1, A.3, A.4, A.8, A.9
56	Analyze the relationship between population and carrying capacity.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.9, GOVT.12, GOVT.13, GOVT.15, VUS.14, WG.1, WG.14, WG.15, WG.16, WG.17, WG.18  Mathematics: A.8, A.9, G.13  Science: BIO.8
57	Research a country's gross domestic product (GDP) and its correlation to resource consumption.	English: 9.3, 9.5, 9.8, 10.3, 10.5, 10.8, 11.3, 11.5, 11.8, 12.3, 12.5, 12.8  History and Social Science: WG.1, WG.14, WG.15, WG.16  Mathematics: A.8, A.9, PS.18
58	Examine the environmental impacts of the extraction and reliance on fossil fuels.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.9, GOVT.12, GOVT.13, GOVT.15, WG.1, WG.14, WG.15, WG.16, WG.17, WG.18  Science: BIO.8
58	Outline a major environmental issue that affects human health and the viability of our planet.	English: 9.6, 9.7, 10.6, 10.7, 11.6, 11.7, 12.6, 12.7  History and Social Science: GOVT.9, GOVT.15, WG.2, WG.3  Science: BIO.8
60	Demonstrate a major technological environmental issue's effect on global and local human health and the viability of our planet.	English: 9.5, 10.5, 11.5, 12.5

		History and Social Science: GOVT.9, GOVT.15, WG.2, WG.3  Science: BIO.8
61	Debate strategies for responding to major environmental issues.	English: 9.1, 10.1, 11.1, 12.1  History and Social Science: GOVT.9, GOVT.15, WG.14, WG.15, WG.16, WG.17, WG.18
62	Explain basic concepts of ecology and environmental science.	English: 9.5, 10.5, 11.5, 12.5  Science: BIO.8
63	Examine the interconnectedness between man-made structures and the natural environment.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.9, GOVT.15, WG.14, WG.15, WG.16, WG.17, WG.18  Science: ES.2
64	Examine definitions of climate change.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8  Science: ES.11
65	Examine the scientific research regarding climate change.	English: 9.5, 9.8, 10.5, 10.8, 11.5, 11.8, 12.5, 12.8  History and Social Science: GOVT.1, GOVT.9, GOVT.15, WG.2, WG.3, WG.4  Mathematics: PS.1*, PS.2*, PS.3*, PS.8*, PS.9*  Science: BIO.1, ES.2, ES.11
66	Research how climate change will impact different regions of the United States.	English: 9.8, 10.8, 11.8, 12.8  Mathematics: A.8, A.9, PS.5, PS.3*, PS.4*  Science: ES.11
67	Examine the economic impacts of climate change.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.9, GOVT.15, WG.14, WG.15, WG.16, WG.17, WG.18

68	Research the impact of mankind's use of technology on the environment.	English: 9.8, 10.8, 11.8, 12.8
69	Compare sustainable alternatives in agriculture.	English: 9.5, 10.5, 11.5, 12.5
70	Identify sustainable alternatives in construction and building management.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: WG.16, WG.17, WG.18  Mathematics: A.1, A.3, A.4
71	Explain the environmental impact of new construction versus renovation.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: WG.16, WG.17, WG.18  Science: ES.2, ES.7
72	Design methods to reduce energy consumption in a given process in building management.	History and Social Science: WG.16, WG.17, WG.18  Mathematics: PS.2*, PS.3*
73	Research how effects from climate change can be mitigated.	English: 9.8, 10.8, 11.8, 12.8
74	Analyze linear and cyclical approaches to life cycles of common technological products.	Mathematics: A.7, A.8, A.9
75	Create a new product from existing products using the cradle-to-cradle approach.	History and Social Science: VUS.14
76	Explain different energy technologies and their capacity to meet the social, economic, and environmental needs for a sustainable future.	English: 9.5, 10.5, 11.5, 12.5  Mathematics: PS.1*, PS.2*
77	Predict the ability of renewable and nonrenewable energy resources to meet future demand.	English: 9.5, 10.5, 11.5, 12.5  Mathematics: PS.5, PS.1*, PS.2*, PS.3*, PS.4*
78	Analyze barriers to implementation of renewable technology and practices.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.9, GOVT.15, WG.16, WG.17, WG.18
79	Propose methods of overcoming barriers to implementation of renewable technology and practices.	English: 9.5, 10.5, 11.5, 12.5  History and Social Science: GOVT.9, GOVT.15, WG.16, WG.17, WG.18
80	Assess the accessibility of renewable technologies within a given geographical area.	English: 9.5, 10.5, 11.5, 12.5  Mathematics: PS.5, PS.1*, PS.2*, PS.3*, PS.4*

81	Measure energy output of a renewable energy source using proper instruments.	Mathematics: A.1, A.3 Science: PH.7
82	Explain the function of the basic components of a photovoltaic system.	English: 9.5, 10.5, 11.5, 12.5
83	Produce a working wind turbine.	Science: PH.7
84	Investigate the effects of light intensity and color on the energy output of a photovoltaic (PV) array.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.4, PH.7
85	Construct a model of a photovoltaic (PV) array and/or wind turbine system that powers a small device.	
86	Investigate how wind speed and direction affect wind turbine energy output.	English: 9.5, 10.5, 11.5, 12.5 Mathematics: AFDA.1 Science: PH.7
87	Explain the basic principles of geothermal and geo-exchange systems.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.7
88	Compare and contrast sustainable alternatives and conventional building practices.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.4

## Teacher Resources

### Basics

[Going-Green-Terminology](#)

[Energy Basics 101](#), U.S. Energy Information Administration, Includes Basic Data by Fuel, as well as Energy Basics by Topic

[Energy Kids](#), U.S. Energy Information Administration

### Living Sustainably

[Carbon Footprint Calculator](#), Carbon Footprint

[Buy, Use, Toss? A Closer Look at the Things We Buy](#), Facing the Future

[Better World Handbook](#), New Society Publishers

### Renewable Energy Resources

[Onsite Renewable Technologies](#), Environmental Protection Agency

[Energy Technologies](#), Union of Concerned Scientists

[Renewable Energy: Recommended Resources](#), Environmental Literacy Council

[Renewable Energy Lesson Plans](#), Texas State Energy Conservation Office

[Sustainable Energy Resources](#), Dartmouth University Sustainability Initiative

[R.E.A.C.T.: Renewable Energy Activities – Choices for Tomorrow: Teacher’s Activity Guide for Middle Level Grades 6-8](#), Rational Renewable Energy Laboratory

[Useful Tools: Teachers](#), New Mexico Energy, Minerals and Natural Resources Department, Energy Conservation and Management Division

[Energy Conservation and Management Division: Links page](#), New Mexico Energy, Minerals and Natural Resources Department

[Renewable Energy Technologies](#), Sandia National Laboratories

[National Wind Technology Center](#)

[Renewable Energy Technologies](#), Renewable Northwest Project

## **Green Careers**

[Clean Energy Jobs and Career Planning](#), Office of Energy & Renewable Energy

## **Blogs and Other Sites Featuring Sustainable and Renewable Technologies and Related Topics**

[Environment, Safety & Sustainability](#)

The Online Ethics Center for Engineering and Research provides resources which include "materials that examine the role of engineers in ensuring the health and safety of the environment, including issues of social justice and sustainable development."

[Inhabit](#), Design Will Change the World.

"Inhabitat.com is a weblog devoted to the future of design, tracking the innovations in technology, practices and materials that are pushing architecture and home design towards a smarter and more sustainable future."

[SustainableBusiness.com](#)

"SustainableBusiness.com provides global news and networking services to help green business

grow, covering all sectors: renewable energy, green building, sustainable investing, and organics."

## Articles on Topics Related to Sustainable and Renewable Technologies

"[Oil's Shame in Africa](#)," Julia Baird; July 18, 2010; *Newsweek*

"[Is Wind Power Green?](#)" Cristen Conger; July 19, 2010; *Discovery News*

"[Do-it-yourself solar power for your home](#)," Cody McCloy; August 17, 2010; CNN

"[Students need math, science focus for green jobs](#)," Dan Heath, Staff Writer; September 13, 2010; *Press Republican*; Plattsburgh, NY

"[Threat of global warming sparks U.S. interest in geoengineering](#)," Juliet Eilperin, Washington Post Staff Writer; Oct. 3, 2010; WashingtonPost.com

"[Google to invest in \\$5 billion wind-power project for Mid-Atlantic](#)," Young-Sam Cho, 2010 Bloomberg News; Oct. 12, 2010; WashingtonPost.com

"[A vision for sustainable restaurants](#)," Arthur Potts Dawson on TED

In addition to the resources listed here, see the CTE Resource Center's [Green Technology featured resources page](#).

## Case Study

### [Human Resources: Triple Bottom Line](#)

Develop implementation plans for HR to address one of the components for sustainability—people or planet.

## Green Building Infusion Units

The Green Building Infusion Unit (GBIU) was designed to encourage teachers to infuse instructional units on green building knowledge and skills into designated CTE courses. The infusion unit is not mandatory, and, as such, the tasks/competencies are marked as “optional,” to be taught at the instructor’s discretion.

## Cybersecurity and Cyber Forensics Infusion Units

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

## **Entrepreneurship Infusion Units**

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

# Appendix: Credentials, Course Sequences, and Career Cluster Information

## Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- 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.*

- Construction Technology (8431/36 weeks)
- Ecology and Environmental Management (8046/36 weeks)
- Energy and Power (8448/36 weeks)
- Energy and Power (8495/18 weeks)
- Fisheries and Wildlife Management (8041/36 weeks)
- Forestry Management (8042/36 weeks)
- Introduction to Natural Resources and Ecology Systems (8040/36 weeks)
- Manufacturing Systems I (8425/36 weeks)
- Materials and Processes Technology (8433/36 weeks)
- Power and Transportation (8445/36 weeks)
- Renewable Energy (8408/36 weeks)

<b>Career Cluster: Agriculture, Food and Natural Resources</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Agribusiness Systems</b>	<b>Farm, Ranch Manager Farmer/Rancher</b>
<b>Animal Systems</b>	<b>Animal Nutritionist Animal Scientist Aquacultural Manager Poultry Manager</b>
<b>Environmental Service Systems</b>	<b>Environmental Compliance Inspector Environmental Sampling and Analysis Technician Hazardous Materials Handler Recycling Coordinator Water Conservationist</b>

<b>Career Cluster: Agriculture, Food and Natural Resources</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Natural Resources Systems</b>	<b>Ecologist</b> <b>Fish and Game Officer</b> <b>Forest Manager, Forester</b> <b>Forest Technician</b> <b>Geological Technician</b> <b>Park Manager</b> <b>Park Technician</b> <b>Range Technician</b> <b>Wildlife Manager</b>

<b>Career Cluster: Manufacturing</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Health, Safety, and Environmental Assurance</b>	<b>Occupational Health and Safety Specialist</b>

<b>Career Cluster: Science, Technology, Engineering and Mathematics</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Engineering and Technology</b>	<b>Agricultural Engineer</b> <b>Architect</b> <b>Chemical Engineer</b> <b>Civil Engineer</b> <b>Civil Engineering Technician</b> <b>Electrical Engineer</b> <b>Electrical Engineering Technician</b> <b>Electro-Mechanical Technician</b> <b>Engineer</b> <b>Engineering Manager</b> <b>Engineering Technician</b> <b>Environmental Engineer</b> <b>Industrial Engineer</b> <b>Industrial Engineering Technician</b> <b>Landscape Architect</b> <b>Manufacturing Systems Engineer</b> <b>Marine Engineer</b> <b>Materials Engineer</b> <b>Mechanical Engineer</b> <b>Mechanical Engineering Technician</b> <b>Nuclear Engineer</b> <b>Petroleum Engineer</b> <b>Power Systems Engineer</b> <b>Statistician</b>
<b>Science and Mathematics</b>	<b>Atmospheric Scientist</b> <b>Botanist</b> <b>Ecologist</b> <b>Environmental Scientist</b> <b>Geoscientist</b>

<b>Career Cluster: Science, Technology, Engineering and Mathematics</b>	
<b>Pathway</b>	<b>Occupations</b>
	<b>Hydrologist</b> <b>Oceanographer</b> <b>Toxicologist</b>

<b>Career Cluster: Transportation, Distribution and Logistics</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Logistics Planning and Management Services</b>	<b>Logistics Analyst</b> <b>Logistics Engineer</b> <b>Logistics Manager</b>
<b>Transportation Systems/Infrastructure Planning, Management and Regulation</b>	<b>Civil Engineer</b> <b>Civil Engineering Technician</b> <b>Traffic Engineer</b> <b>Transportation Manager</b> <b>Urban, Regional Planner</b>
<b>Warehousing and Distribution Center Operations</b>	<b>Traffic Engineer</b> <b>Transportation Manager</b>