Sustainable Development – Grade Eight

Ohio Standards Connections

Technology

Nature of Technology

Benchmark B
Apply the core concepts of technology in a practical setting.

Indicator 2
Examine parameters and constraints in the design of a product or system.

Indicator 5
Recognize that trade-offs are the result of the decision-making process, involving careful compromises among competing factors.

Technology and Society Interaction

Benchmark A
Analyze technologically responsible citizenship.

Indicator 1
Explain how economic, political and cultural issues are influenced by the development and use of technology.

Indicator 2
Describe how societal expectations drive the acceptance and use of products and systems.

Lesson Summary:
Students learn how sustainable development affects economic, social and environmental issues in both a positive and a negative way. Students investigate consumer choice and how it impacts the environment. They pair with other students to research an environmental issue and solution that has the least impact on the environment. Students choose one solution, explore it in depth and create a handout about their findings. They prepare an analysis that demonstrates their solution and present it to the class. One student presents the potential benefits of the solution while the other student presents the potential negative ramifications this solution will have on economic, political, and cultural issues.

This lesson provides opportunity for science, social studies, and English language arts teachers to work with students in a technology education class investigation of sustainable development and environmental health issues.

Estimated Duration: *Five hours and 25 minutes (Seven, 45 minute class periods.)*

Commentary:
This lesson shows the students the need to strive to use renewable resources and minimize our impact on the environment. Students become aware of the need to manage use of non-renewable resources so that future generations will also have them for their use. This type of lifestyle change will have economic, political and cultural impact and influence the design of products and structures.

Pre-Assessment:

1. Lead students through the following discussion questions:
   - What is energy conservation? (Using energy efficiently or energy saving practices)
   - Should we conserve the resources such as oil, coal, and natural gas we have now so future generations will have them? (If we use all the resources, then future generations will not have those resources.)

Indicator 3
Describe how the use of technology affects humans in various ways, including their safety, comfort, choices and attitudes about technology's development and use.

Benchmark B
Describe and explain the impact of technology on the environment.

Indicator 1
Explain how the life-cycle of a product or structure may impact the environment.

Indicator 2
Identify items/products that would benefit the environment if they were designed to be biodegradable.

Benchmark E
Assess the impact of technological products and systems.

Indicator 3
Analyze responses to an environmental health concern and identify the types of solutions to that problem (e.g., psychological/social responses; political, legal and economic processes; environmental controls; waste/ material management).

- What does sustainable development mean? (Development that meets the needs and aspirations of the current generation without compromising the ability to meet those of future generations.)
- What are some examples of "Green Building" design practices in our community? (Examples might include passive solar foyer, solar panels, vegitated roofs, high efficiency appliances, low water use devices, energy saving windows, controlled storm water run-off, products made from recycled materials.)
- What does "environmental health" mean? (It concerns the interface between human health and health stressors from the environment. Stressors may be physical, chemical, soil or food. Solutions may include personal responses, political and legal processes, environmental controls and waste and materials management.)

2. Have students list on paper three health issues that are caused or made worse by environmental factors and what solution might rectify the problem.
3. Write a list of their responses on the board.
4. As they share their ideas, challenge their thinking by debating the ramifications of their solutions to ensure balanced and objective discussion of trade-offs. For example, if a student suggests reducing air pollution by purchasing smaller cars, argue that this choice might result in more severe injuries in accidents.
5. Ask students if they understand what the "life cycle" of a product means. (The period of time from when the idea for a product or service is conceived until the time it is no longer available for use and is discarded or recycled.)
6. Determine if they can suggest some products that are more environmentally-friendly than others in their life cycle. (Disposed of properly, old paint cans or used oil can be safe; however, if thrown into a landfill, it can contaminate ground water and make people sick. Aluminum soda cans and many plastic items can be recycled and made into other products. Products manufactured so that all parts are recyclable.)
7. Discuss whether or not most consumers consider environmental issues when they make product choices. (If you shop for a lawn mower, should you buy one with a

Technology and Communication Applications

Benchmark B
Develop, publish and present information in a format that is appropriate for content and audience.

Indicator 1
Construct and publish information in printed and electronic form (e.g., printed reports, resumes, brochures, charts and electronic presentations, videos, Web sites).

2-stroke engine or one with a 4-stroke engine? Consider: a 4-stroke engine pollutes less but usually costs more. Discuss the trade-off; are consumers willing to pay more to pollute less?)

8. Hand out Attachment A, *Sustainable Development Survey*. Review the directions and strategies for interviewing adults and ask students to return the completed assignment the next day.

Scoring Guidelines:
Observation of students in class discussion. Determine level of student understanding of sustainable development ideas.

Post-Assessment:
Students will research and propose a sustainable development model. Although they may work in pairs, each student must turn in his or her own assignments. Students are evaluated on how well they have researched their solution, conveyed that information in their reports and conducted their analysis.

Scoring Guidelines:
Attachment B, *Sustainable Development Post-Assessment.*

Instructional Procedures:
Day One

4. Do pre-assessment discussion activities. Assign Attachment A, *Sustainable Development Survey* as an at home activity. To find articles on related topics, consult the INFOhio database for full-text articles: htpp://www.infohio.org.

Day Two

5. Discuss information gathered on surveys and point out that all choices have positive and negative consequences.
6. Discuss why people choose to purchase certain products and services and how their choices impact the environment. Do people consider how recyclable a product is? Do they consider if it is environmentally friendly? If people chose environmentally- friendly products, could some environmental health issues be minimized?

4. Discuss the purpose of the Energyguide label on appliances and how to read it. (http://www.eere.energy.gov/consumerinfo/energy_savers/label.html)
5. Hand out the Attachment C, *Health Issues Worksheet* or put the worksheet up on a screen where students can see it. List some health issues, what causes them, and what can be done to help minimize these causes.
6. Pose the possibility that a community chooses a lifestyle which includes sustainable development. Discuss what economic, political, and cultural issues could arise?
7. Discuss environmental issues caused by actions not consistent with sustainable development. Refer to Attachment A, *Sustainable Development Survey* that the students completed.
8. Hand out Attachment D, *Student Assignment Sheet*. Go over assignment with students.
9. Match up student pairs. Direct students to choose a problem area, select one solution supporting sustainable development and decide upon their research plan.

Day Three

10. Provide students with time and materials to complete their research. Inform SLMs about students' research topics and arrange time for library and computer lab access. Coach students on how to use *Ohio Research Model Skills*, Attachment G.

Day Four

11. Have students complete Attachment E, *Sustainable Development Report.* Using the report worksheet, students create an informational handout for consumers on this solution. Use Attachment F as a sample.

Day Five

12. Have students finish the handout and start planning their analysis.

Day Six

13. Have students prepare an analysis that represents all aspects of their solution.

Day Seven

14. Have students present their handouts and analysis to the class. Since all solutions will have both a positive and a negative impact on society, one student will present the solution's positive impact and the other student will present the solution's negative impact. The presentation should address economic, social, and environmental outcomes that are positive and negative.

Differentiated Instructional Support:

Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicators(s).

- Students working toward standard make their presentation by using 3 x 5 cards and turn them in as their report.

- Challenge students to take the information in their reports and write articles which are published in the school's newspaper or the local community newspaper and/or make a presentation to the local government or a service club.

Extensions:
- Research a career field related to the technical content used in their analysis.
- Analyze "cradle to cradle" product design and describe how it could be applied to a common product. McDonough and Braungart's cradle to cradle design theory involves designing products from the outset so that after useful lives they will be utilized for something new.
- Study recommendations posted on the Local Government Commission, Center for Livable Communities website and determine which plans best match the needs of your community.

Home Connections:
- Find an article in a newspaper or magazine from home that promotes sustainable development. Write a paragraph about the article and staple the article to the paragraph.
- Interview family members, neighbors, business owners about a community sustainable development issue.

Materials and Resources:
The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. The Web addresses listed are for a given site's main page; therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the Internet changes over time; therefore, the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.

Note: Some Web sites contain material that is protected by copyright. Teachers should ensure that any use of material from the Web does not infringe upon the content owner's copyright.

For the teacher: chart paper, markers

For the student: paper, pen or pencil, materials for preparing analysis

Potential Web-based resources include:
- Local Government Commission Center for Livable Communities - www.lgc.org/
- U.S. Environmental Protection Agency - www.epa.gov
- Farmland Information Center - www.farmlandinfo.org

- The U.S. Department of Agriculture - www.usda.gov
- U.S. Geological Survey - www.usgs.gov
- Lincoln Institute of Land Policy - www.lincolninst.edu/index-high.asp
- Johns Hopkins Bloomberg School of Public Health's Global Environmental Change and Our Health - www.jhsph.edu/globalchange
- USGS Science for a Changing World - www.usgs.gov/themes/environ.html
- United Nations Division for Sustainable Development - http://www.un.org/esa/sustdev/index.html
- National Institute of Environmental Health Sciences http://www.niehs.nih.gov
- Green Energy Ohio - http://www.greenenergyohio.org
- Energy Savers - http://www.eere.energy.gov/consumerinfo/energy_savers/
- Renewable Energy at Home - http://www.nrel.gov/docs/fy00osti/27684.pdf
- GreenBlue - http://www.greenblue.org/about.html
- Advanced Technology Environmental Education Center – http://www.ateec.org/links/envir_tech_links.cfm
- The Cloud Institute for Sustainability Education - http://www.sustainabilityed.org/index1.htm

Vocabulary:

- air quality
- biodegradable
- city planning
- economic growth
- ecosystem
- environment
- environmental health
- pollution
- problem-solving
- product lifecycle
- recycle
- renewable resources
- sustainable
- water quality

Library Connections:

In 2003, the State Board of Education and the Ohio Department of Education established library guidelines that represent a standards-based education approach to school library programs. Entitled Academic Content Standards K-12 Guidelines Library, Ohio's library guidelines provide a variety of content-specific, grade-level indicators describing information literacy, literacy linked to library-based technologies, and media literacy experiences for students. Featured on pages 204-219 are sample activities for making library

connections across academic content standards and disciplines. Also included are grade-band models for student research and specific information concerning copyright and fair use of materials laws. K-12 teachers are encouraged to utilize the library guidelines and collaborate with the school library media specialist whenever possible. Ohio's library guidelines can be found under the heading of Library at www.ode.state.oh.us, keyword search Library.

Specific examples of how library resources can be used to support this lesson are listed below:

- Students search current newspapers and periodicals for information.
- Students access an electronic online library link to access technical information from sources outside the building.

Library Guidelines:
Information Literacy
Benchmark E
Conduct research and follow a research process model that includes the following: develop essential question; identify resources; select, use and analyze information; synthesize and generate a product; and evaluate both process and product.
Indicator 1
Formulate an essential question to guide the research process.
Indicator 2
Identify and evaluate relevant information and select pertinent information found in each source.
Indicator 5
Seek information from a variety of viewpoints.
Indicator 9
Examine diverse opinions and points-of-view to develop and modify individual point-of-view (e.g., view culture, background, historical context).
Indicator 10
Take notes, organize information into logical sequence, and create a draft product (e.g., report, research paper, presentation).
Indicator 14
Evaluate the final product for its adherence to project requirements. (e.g., recognize weaknesses in process and product and find ways to improve).

Research Connections:
Marzano, R. et al. *Classroom Instruction that Works: Research-based Strategies for Increasing Student Achievement*. Alexandria: Association for Supervision and Curriculum Development, 2001.

1. Homework and practice provide students with opportunities to deepen their understanding and skills related to content hat has been presented to them.
2. Cooperative learning has a powerful effect on student learning. This type of grouping includes the following elements:

- Positive interdependence,
- Face-to-face promotive interaction,
- Individual and group accountability,
- Interpersonal and small group skills, and
- Group processing.

3. Setting objectives and providing feedback establishes a direction for learning and a way to monitor progress. This provides focus on learning targets and specific information to allow the student to make needed adjustments during the learning process, resulting in increase student learning.
4. Generating and testing hypotheses engages students in one of the most powerful and analytic of cognitive operations. It deepens students' knowledge and understanding. Any of the following structured tasks can guide students through this process:
   - Systems analysis,
   - Problem solving,
   - Historical investigation,
   - Invention,
   - Experimental inquiry,
   - Decision making.
5. Cues, questions, and advanced organizers help students retrieve what they already know about a topic. Activating prior knowledge is critical to learning new concepts.

Daniels, H., and Bizar, M. *Methods that Matter: Six Structures for Best Practice Classrooms,* Portland, ME: Stenhouse Publishers, 1998.

> Authentic experiences help students develop real-world knowledge and skills and apply their learning in ways that prepare them for their careers and lives beyond school.

Edelson, D., Gordin, D., Pea, R. (1999). Addressing the Challenges of Inquiry-Based Learning, Technology and Curriculum Design. *Journal of the Learning Sciences*, 8(3-4), 391-450.

> Inquiry-based learning helps students to become resourceful, effective investigators and problem-solvers. Research reports that with effective teacher facilitation, student-centered inquiry projects can reverse patterns of underachievement. Inquiry-based projects can build learning communities that foster communication skills, interpretive abilities and an understanding of issues from a variety of perspectives.

Technology for All Americans Project, Measuring Progress: A Guide to Assessing Students for Technological Literacy, Reston, VA: International Technology Education Association, 2004.

> Standards-based student assessment supports the systematic, multi-step process of collecting evidence on student learning, understanding and abilities and using that

information to inform instruction and provide feedback to the learner, thereby enhancing learning. Students should be assessed often using a variety of tools and methods. The design of student assessments should follow set principles, such as utilizing authentic assessment that provides students the opportunity to demonstrate their knowledge and abilities in real-world situations. Note: the complete publication and other resource materials are available online at the Ohio page of the ITEA Center to Advance the Teaching of Technology and Science [CATTS] web link: http://www.iteaconnect.org/EbD/CATTSresources/CATTSresourcesOH01.htm

Attachments:

Attachment A, *Sustainable Development Survey*
Attachment B, *Sustainable Development-Post-Assessment*
Attachment C, *Sustainable Development-Health Issues Worksheet*
Attachment D*, Sustainable Development-Assignment Sheet*
Attachment E, *Sustainable Development-Report Worksheet*
Attachment F, *Sustainable Development Report Sample*
Attachment G*, Ohio Research Model Skills (Grades 6-8)*

Attachment A
Sustainable Development Survey

Student Name:_____
Ask three adults:

- What are the criteria used to purchase the following items?
- How does conserving resources, an environmentally-friendly product design, or the product's life cycle enter into their decision?

Adult's Name	Item Purchased	Criteria for Making Choice	Environmental Issues
1.	Refrigerator		
	Automobile		
	Lawn Mower		
2.	Refrigerator		
	Automobile		
	Lawn Mower		
3.	Refrigerator		
	Automobile		
	Lawn Mower		

Attachment B
Sustainable Development – Post-Assessment

Criteria	Excellent	Good	Satisfactory	Needs Improved
Understand the compromises made between competing factors	Thoroughly explains the compromises made between competing factors in a designed product or system.	Explains most of the compromises made between competing factors in a designed product or system.	Explains some of the compromises made between competing factors in a designed product or system.	Does not understand the compromises made between competing factors in a designed product or system.
Technology's impact on society's economic, political and cultural issues	Clearly understands that technology impacts societal issues.	Identifies some of the impacts that technology has on societal issues.	States a technological impact and a few societal issues.	Unclear demonstration of the way technology impacts societal issues.
Identify various affects of technology on people	Effect that technology has on people is clearly and precisely communicated and it includes safety, comfort, and people's view point on technology use.	Effect that technology has on people is mostly communicated and it includes safety, comfort, and people's view point on technology use.	Effect that technology has on people is communicated and it includes some information on the safety, comfort and people's view point on technology use.	Unclear demonstration of how technology has affected people.

Attachment B, Continued

Criteria	Excellent	Good	Satisfactory	Needs Improved
Summarize product life cycle	The life cycle of a product is clearly explained.	The life cycle of a product is somewhat explained.	The life cycle of a product is missing some major steps.	The life cycle of a product is not explained well.
Identify biodegradable products and how they benefit the environment	A biodegradable product is identified and its benefit to the environment is clearly explained.	A biodegradable product is identified and its benefit to the environment is mostly explained.	A biodegradable product is identified and its benefit to the environment is somewhat explained.	A biodegradable product is not identified and its benefit to the environment is not developed clearly.
People's attitudes about technology's development and use	The attitude people have about technology's development and use is thoughtfully explained and summarized.	The attitude people have about technology's development is mostly explained.	The attitude people have about technology's development is somewhat summarized.	The attitude people have about technology's development is not developed clearly.
Develop, publish and present information	Information is well developed, published and presented in a format appropriate for the audience.	Information is mostly developed, published and presented in a format appropriate for the audience.	Information is somewhat developed, published and presented in a format appropriate for the audience.	Information is not developed well, published and presented in a format appropriate for the audience.
Summarizes a solution to a problem with a report and technical analysis	A relevant environmental health concern and solution is thoughtfully summarized and an effective solution is displayed.	A relevant environmental health concern and solution is summarized and a possible solution is displayed.	An environmental health concern and solution is stated and the solution is displayed.	An environmental health concern and solution is unclear.

Attachment C
Sustainable Development
Health Issues Worksheet

List a health issue, at least one environmental factor that contributes to that health issue and at least one possible solution to the environmental factor.

Health Issues	Environmental Factors	Solutions

Attachment D
Student Assignment Sheet

Assignment: Explore a solution to an environmental issue that promotes sustainable development. Address both the negative and positive consequences that the solution will have on the economic, political and cultural aspects of society.

1. Work with a research partner.
2. Decide upon an environmental issue to address.
3. Develop a solution to the problem that promotes sustainable development.
4. Include information about how your solution will have minimum impact on the environment and promote renewable or reusable products.
5. After researching the topic, create a handout which shows the information.
6. Prepare an analysis of the solution.
7. Explain the analysis report findings in a class presentation and distribute the handout. Use either a graphic computer display or distribute the handout for the presentation.
8. Have one partner present the potential positive consequences of the solution while the other person presents the potential negative consequences.
9. Include the following in the presentation:
   - Reliable information - at least three sources that validate the findings.
   - A bibliography - use a standard accepted format (examples provided)

Bibliography Guideline
Use the following format for an electronic reference such as a web page:

(Author last name), Author First Initial, Author Middle Initial. (Year work was created). Title of the work Retrieved (month, day, year), from (source web site).

Sources other than electronic should be documented according to standard accepted format which can be located at http://www.apastyle.org/

Attachment E
Sustainable Development Report

Problem:

Possible Solutions:

Solution:

Why was this solution chosen?

Economic Outcome	
Positive Effect:	Negative Effect:

Social Outcome	
Positive Effect:	Negative Effect:

Attachment E, Continued

Environmental Outcome	
Positive Effect:	Negative Effect:
Bibliography- List sources used.	

Attachment F
Sustainable Development Report Sample

Problem: Four people need cost effective way to travel from Ohio to Florida
Possible Solutions: Drive by car, take airplane, take train
Solution: Drive a hybrid car
Why was this solution chosen? Hybrid car has the highest gas mileage.

Economic Outcome	
Positive Effect: • Four people get to Florida by splitting the cost of gas. • Alternative vehicle use promotes development of new technologies. • All four people saved money. • No motel bill since the four people slept while others drove.	Negative Effect: • Hybrid car costs more. • Less steel is needed for smaller cars thus need fewer steel workers. • Less gas used, less demand on oil, need fewer oil workers.

Social Outcome	
Positive Effect: • Inside the car, there is privacy. • You will get to know three other people better. • Public health improves	Negative Effect: • You have only three other people with whom to interact. • You may become irritated at one or more of the other people in the car.

Environmental Outcome	
Positive Effect: • Uses less gas; conserves oil recourses. • There will be fewer hydrocarbons released into the air.	Negative Effect: • Car requires large lead cell batteries; lead is a hazardous metal. • Limited number of recharging stations available.

Attachment G
Ohio Research Model Skills (Grades 6-8)

Decide: Formulate an essential question to guide the research process.

Find: Identify and evaluate relevant information and select pertinent information found in each source. Expand search strategies by using Boolean logic. Narrow or broaden search topic or question according to how many resources are located. Seek information from a variety of viewpoints.

Use: Analyze information, finding connections that lead to a final information product. Demonstrate how to determine copyright issues when creating new products (e.g., permissions to use articles and graphics, credit information to be included). Use a teacher or district designated citation-style manual to credit sources used in work (e.g., MLS Style Manual, APA Guidelines). Examine diverse opinions and points-of-view to develop and modify own point-of-view (e.g., view culture, background, historical context). Take notes, organize information into logical sequence, and create a draft product (e.g., report, research paper, presentation). Digitize information for archiving and future use (e.g., creating an electronic portfolio of curricular projects).

Check: Revise and edit the information product. Communicate, publish and disseminate the findings to multiple audiences in a variety of formats (e.g., report, speech, presentation or Web site). Evaluate the final product for its adherence to project requirements (e.g., recognize weaknesses in the process and product and find ways to improve them).

Adapted from Ohio K-12 Library Guidelines, 2004 pg. 198
Source: Office of Curriculum and Instruction. Ohio K-12 Library Guidelines Columbus, OH: Ohio Department of Education; 2004