Technology Alignment of Benchmarks and Indicators
GRADE 9

Standard 1 Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts* and relationships between technologies and other fields. Students learn that technology extends human potential by allowing people to do things more efficiently than they would otherwise be able to do. Students learn that useful technological development is a product of human knowledge, creativity, invention, innovation, motivation and demand for new products and systems. They learn that the natural and human-made designed worlds are different, and that tools and materials are used to alter the environment. Students learn that the development of emerging technology is exponential, driven by history, design, commercialization, and shaped by creative/inventive thinking, economic factors and cultural influences.*The core concepts of technology include systems, resources, requirements, optimization and trade-offs, processes and controls.

Benchmark A: Synthesize information, evaluate and make decisions about technologies.

Grade Nine

Technology Diffusion

1. List and describe factors that may influence the development of technology.

Goal-directed Research

2. Describe goal-directed research, define invention and innovation, and explain the relationship among them.

Commercialization of Technology

3. Make informed choices among technology systems, resources and services.

Benchmark B: Apply technological knowledge in decision-making.

Grade Nine

Optimization and Trade-offs

1. Demonstrate how the stability of a technological system is influenced by all system components, especially those in the feedback loop.

Benchmark C: Examine the synergy between and among technologies and other fields of study when solving technological problems.

Grade Nine

Technology Transfer

1. Describe how technology transfer occurs when an innovation in one setting is applied in a different setting.

Innovation and Invention

2. Describe how technologies are, or can be, combined (e.g., a computer-controlled surgical laser scalpel represents the combination of physical, information and bio-related technology).

Standard 2 Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.Students learn that the interaction between society and technology has an impact on their lives, that technology may have unintended consequences which may be helpful or harmful. They learn that interaction of technology will affect the economy, ethical standards, environment and culture. Students evaluate the impact of products or systems by gathering and synthesizing information, analyzing trends and drawing conclusions. Students analyze technological issues and the implications of using technology. They acquire technological understanding, and develop attitudes and practices that support ethical decision-making and lifelong learning.

Benchmark A: Interpret and practice responsible citizenship relative to technology.

Grade Nine

Technology and Citizenship

1. Explain how making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

2. Understand that ethical considerations are important in the development, selection and use of technologies.

3. Review how different factors, such as individual curiosity, advertising, the strength of the economy, the goals of a company and the current trends, contribute to shaping the design of and demand for various technologies.

4. Understand how different cultures develop their own technologies to satisfy their individual and shared needs, wants and values.

Technology Transfer

5. Provide examples of technology transfer from a government agency to private industry, and discuss the benefits (e.g., global positioning systems—GPS, Internet).

Benchmark B: Demonstrate the relationship among people, technology and the environment.

Grade Nine

Technology and Environment

1. Design, model/build and evaluate a plan/method for conserving resources.

2. Investigate the use and development of appropriate technologies to meet the needs of persons living in developing countries (e.g., hand-crank powered radio for communication).

3. Describe the economic impact of invasive foreign species present in Ohio as a result of technology activity or other human intervention.

Benchmark C: Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

Grade Nine

Technology and History

1. Describe how some technological development has been evolutionary, the result of a series of refinements to basic inventions or innovations over time.

2. Select a technology or tool and predict how it will change in the future.

Benchmark D: Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

Grade Nine

Technology and Ethics

1. Practice responsible usage of technologies (e.g., download legally, install licensed software, adhere to copyright restrictions).

2. Discuss access to information in a democratic society.

Benchmark E: Forecast the impact of technological products and systems.

Grade Nine

Technology Assessment

1. Collect information about products and systems and evaluate the quality of that information.

2. Describe criteria for assessing the quality of information.

3. Compare and contrast the past, present and future developments of a technological system.

<u>Standard 3 Technology for Productivity Applications</u>

Students learn the operations of technology through the usage of technology and productivity tools. Students use computer and multimedia resources to support their learning. Students understand terminology, communicate technically and select the appropriate technology tool based on their needs. They use technology tools to collaborate, plan and produce a sample product to enhance their learning, and solve problems by investigating, troubleshooting and experimenting using technical resources.

Benchmark A: Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

Grade Nine

Understanding Operations

1. Explore state-of-the-art devices to store data that will be used for researching projects.

2. Create a design for a basic network and list skills needed to manage networks.

Problem-solving

3. Describe strategies for identifying and solving routine hardware and software problems that occur during everyday use.

Benchmark B: Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-

enhanced models.

Grade Nine

Understanding Operations

1. Identify and use input and output devices to operate and interact with computers and multimedia technology resources (e.g., digital video camera, mobile cameras-a camera on a robot base, like a Mars rover, how to connect analog equipment to digital equipment).

Productivity Tools

2. Demonstrate proficiency in all productivity tools (e.g., word processing, spreadsheet, database, desktop publishing).

<u>Standard 4 Technology and Communication Applications</u>

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning. Students acquire and publish information in a variety of media formats. They incorporate communication design principles in their work. They use technology to disseminate information to multiple audiences. Students use telecommunication tools to interact with others. They collaborate in real time with individuals and groups who are located in different schools, communities, states and countries. Students participate in distance education opportunities which expand academic offerings and enhance learning.

Benchmark A: Apply appropriate communication design principles in published and presented projects.

Multimedia Applications

1. Format text, select color, insert graphics and include multimedia components in student-created media/communication products.

Accessibility Guidelines

2. Modify electronic publications and other communication products to meet accessibility guidelines so that access to information is not limited.

Evaluation

3. Examine how and why image, language, sound and motion convey specific messages designed to influence the audience.

4. Assess the accuracy of the communication product.

Benchmark B: Create, publish and present information, utilizing formats appropriate to the content and audience.

Grade Nine

Use of Communications

1. Use e-mail in a teacher-moderated discussion group and in threaded discussion lists.

2. Use technology to publish information in electronic form (e.g., Web, multimedia, digital video, electronic portfolio).

Evaluation

3. Validate use of communication techniques.

Benchmark C: Identify communication needs, select appropriate

communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.

Grade Nine

Use of Communications

1. Demonstrate communication clarity and use elements and formats of e-mail to communicate with others (e.g., discussion lists, message boards, chat, instant messaging).

2. Identify and use the appropriate communication tool to collaborate with others (e.g., presentation,Web site, digital video).

3. Investigate the uses of video-conferencing, Web casting, and other distance-learning technologies (e.g., interviews, meetings, course work).

4. Develop collaborative online projects to research a problem and disseminate results.

<u>Standard 5 Technology and Information Literacy</u>

Students engage in information literacy strategies, use the Internet, technology tools and resources, and apply information-management skills to answer questions and expand knowledge. Students become information-literate learners by utilizing a research process model. They recognize the need for information and define the problem, need or task. Students understand the structure of information systems and apply these concepts in acquiring and managing information. Using technology tools, a variety of resources are identified, accessed and evaluated. Relevant information is selected, analyzed and synthesized to generate a finished product. Students evaluate their information process and product.

Benchmark A: Determine and apply an evaluative process to all information sources chosen for a project.

Grade Nine

Evaluating Sources

1. Define terms which determine information validity:

a. Accuracy;

b. Authority;

c. Objectivity;

d. Currency; and

e. Coverage (including objectivity and bias).

2. Determine the author's authority for all resources and identify points of agreement and disagreement among sources.

Benchmark B: Apply a research process model to conduct research and meet information needs.

Grade Nine

Decide

1. Determine the essential questions and plan research strategies.

Find

2. Select and evaluate appropriateness of information from a variety of

resources, including online research databases and Web sites to answer the essential questions.

Use

3. Integrate copyrighted information into an information product, following appropriate use of guidelines (e.g., quote using proper citation format, request permission for use).

4. Identify relevant facts, check facts for accuracy and record appropriate information.

5. Incorporate a list of sources used in a project using a standard bibliographic style manual (e.g., MLA and APA Style Manuals).

Check

6. Evaluate the research process and product as they apply to the information need (e.g., does the process reflect the actual information need).

Benchmark C: Formulate advanced search strategies, demonstrating an understanding of the strengths and limitations of the Internet, and evaluate the quality and appropriate use of Internet resources.

Grade Nine

Search Strategies

1. **Identify multiple directories and search engines matching curricular need (e.g., given an assignment, use knowledge of tools to pick an appropriate tool to search for information).**

2. Construct search strategies focused on the retrieval of specific search results by incorporating Boolean operators "AND" "OR" "NOT" and adjacency/proximity techniques.

3. Compare and chart the search results from multiple Web sites to check for consistency of information (e.g., compare data on acid rain from more than one site).

Evaluating Sources

4. Establish a criteria for evaluating the information retrieved through Internet searching: author's expertise, bias, coverage of topic and timeliness.

Benchmark D: Evaluate choices of electronic resources and determine their strengths and limitations.

Grade 9

Electronic Resources

1. Integrate search strategies within the electronic resource that targets retrieval for specific information need (e.g., limit by date of publication, focus on specific format such as image, sound file).

2. Review strengths and weaknesses of various types of electronic resources for research need (e.g., compare subject specific magazine database to general online index of articles).

3. Demonstrate the difference between databases, directories and database archives (e.g., free vs. fee-based, delivery mechanism, such as CD, DVD, network, Internet, and general vs. specific discipline).

4. Select a specific database for an assignment and explain why it is the appropriate one to use (e.g., in researching a particular author, use a literary database of biographical and critical information about writers).

Standard 6 Design

Students will apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment. Students recognize the attributes of design; that it is purposeful, based on requirements, systematic, iterative, creative, and provides solution and alternatives. Students explain critical design factors and/or processes in the development, application and utilization of technology as a key process in problem-solving. Students describe inventors and their inventions, multiple inventions that solve the same problem, and how design has affected their community. They apply and explain the contribution of thinking and procedural steps to create an appropriate design and the process skills required to build a product or system. They critically evaluate a design to address a problem of personal, societal and environmental interests. Students systematically solve a variety of types of problems using different design approaches including troubleshooting, research and development, innovation, invention and experimentation.

Benchmark A: Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

Grade Nine

***Design Process* 1. Explain and apply the methods and tools of inventive problem-solving to develop and produce a product or system.**

2. Define simulation in the design process.

Technical Contradictions

3. Identify the conceptual and technical principles that underpin design processes (e.g., analyze characteristics of technical systems that affect performance and identify principles that resolve design contradictions).

Requirements

4. Identify the elements of quality in a product/system (e.g., tolerances, fit, finish, function, form (aesthetics), repeatability, durability, material).

Optimization and Trade-offs

5. Explain that design problems are seldom presented in a clearly defined form (e.g., problems often involve competing constituencies, undiscovered constraints and unidentified regulations).

Technical Problem-solving

6. Brainstorm solutions to problems using common brainstorming techniques (e.g., select a leader, select a recorder, generate ideas, discuss and add-on to ideas of others and recognize all ideas are welcome).

Technical Communication

7. Demonstrate knowledge of pictorial and multi-view CAD drawings (e.g., orthographic projection, isometric, oblique, perspective using proper

techniques).

Intellectual Property

8. Recognize that patent, trademark and copyright law protect technological ideas and intellectual property.

Understanding Technological Systems

9. Describe how the technological systems of manufacturing, construction, information and communication, energy and power, transportation, medical, and agricultural, and related biotechnologies can be used to solve practical problems.

Benchmark B: Recognize the role of teamwork in engineering design and of prototyping in the design process.

Grade Nine

Design Process

1. Explain how established design principles are used to evaluate existing designs, collect data and guide the design process (e.g., design principles include flexibility, unity, emphasis, balance, function and proportion).

2. Explain how a prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

3. Create a model of a design solution to an engineering problem (e.g., virtual, physical, graphic or mathematical model).

Requirements

4. Identify the factors that must be taken into account in the process of engineering design (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors in engineering, such as ergonomics).

Design Team Collaboration

5. Describe how engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.

6. Describe the importance of teamwork, leadership, integrity, honesty, work habits and organizational skills of members during the design process.

Technical Careers

7. Explain the different engineering disciplines and how they relate to the major technological systems (e.g., mechanical—manufacturing, audio—communication, civil—construction).

Benchmark C: Understand and apply research, development and experimentation to problem-solving.

Grade Nine

Research and Development

1. Describe how business and industry use research and development to prepare devices and systems for the marketplace.

Market Research

2. Research consumer preferences for a new product.

Quality Design

3. Explain that function is the purpose for which a product/system was designed and that focus on the function will expand the space in which solutions are available.

Idea Generation

4. Identify factors that inhibit creativity (e.g., perceptual, emotional, cultural, functional, environment).

5. Identify and apply a variety of conceptual block-busting techniques (e.g., goal charting, bug lists, brainstorming, forced connections and attribute listing).

<u>Standard 7 Designed World</u>

Students understand how the physical, informational and bio-related technological systems* of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, impact, issues and career connections. Students learn that the designed world consists of technological systems* reflecting the modifications that humans have made to the natural world to satisfy their own needs and wants. Students understand how through the design process the resources: materials, tools and machines, information, energy, capital, time and people are used in the development of useful products and systems. Students develop a foundation of knowledge and skills through participation in technically oriented activities for the application of technological systems. Students demonstrate understanding, skills and proficient use of technological tools, machines, instruments, materials and processes across technological systems in unique and/or new contexts. Students identify and assess the historical, cultural, environmental, governmental and economic impacts of technological systems in the designed world. *The technological systems areas include energy and power technologies, transportation technologies, manufacturing technologies, construction technologies, information and communication technologies, medical technologies, agricultural and related biotechnologies.

Benchmark A: Classify, demonstrate, examine, and appraise energy and power technologies.

Grade Nine

Understanding Technological Systems

1. Describe and demonstrate ways that energy can be converted from one form to another (e.g., heat to electrical, electrical to mechanical, electrical to heat).

2. Identify the differences between open and closed thermal systems (e.g., humidity control systems, heating systems, cooling systems).

Technical Careers

3. Describe the careers available in energy and power technological

systems and the training needed to pursue them.

Safety

4. Identify and apply appropriate safety measures when working with energy and power technologies.

Engineering Practice

5. Measure voltage, resistance and current in electrical systems and describe the different instruments used.

6. Describe the application of the first and second laws of thermodynamics (e.g., the concept and function of a heat engine).

Use and Maintain Technological Systems

7. Differentiate between hydraulic and pneumatic systems and provide examples of appropriate applications of each as they relate to manufacturing and transportation systems.

8. Identify and investigate AC and DC circuits (e.g., sources, conductors, controls, loads, applications, purposes, safety, components, symbols, principles and operations).

9. Employ energy and power technologies to resolve practical problems (e.g., efficient power production, conversion and transmission).

Technology Assessment

10. Use and evaluate renewable and nonrenewable resources to operate a mechanism (e.g., petroleum, coal, biomass and solar).

Emerging Technology

11. Investigate emerging (state-of-the-art) and innovative applications of energy and power technology (e.g., fuel cells, distributed generation).

Benchmark B: Classify, demonstrate, examine and appraise transportation technologies.

Grade Nine

Technical Careers

1. Describe the careers available in transportation technological systems and the education needed to pursue them.

System Management

2. Describe the vital role transportation plays in the operation of other technologies, such as manufacturing, construction, communication, health and safety, and agriculture (e.g., subsystems of aviation, rail transportation, water transportation, pedestrian walkways, roadways).

Safety

3. Identify and apply appropriate safety measures when working with transportation technologies.

Use and Maintain Technological Systems

4. Employ transportation technologies to resolve practical problems (e.g., getting students to athletic events).

Benchmark C: Classify demonstrate examine and appraise manufacturing technologies.

Grade Nine

Technical Careers

1. Describe the careers available in manufacturing technological systems and the education needed to pursue them.

System Management

2. Produce a product using the manufacturing system appropriate to the context (e.g., customized production, batch production and continuous production).

Safety

3. Identify and apply appropriate safety measures when working with manufacturing technologies.

Use and Maintain Technological Systems

4. Classify materials as natural, synthetic or mixed (e.g., wood, plastic, cotton/polyester blend fabric).

5. Employ manufacturing technologies to resolve practical problems (e.g., produce a product).

Technology Assessment

6. Identify and investigate a variety of technological tools, equipment, machines, materials and technical processes used in manufacturing technologies to manufacture/fabricate products or systems.

Emerging Technology

7. Investigate emerging (state-of-the-art) and innovative applications of manufacturing technology.

Benchmark D: Classify, demonstrate, examine and appraise construction technologies.

Grade Nine

Technical Careers

1. Describe the careers available in construction technological systems and the education needed to pursue them.

System Management

2. Describe the importance of infrastructure in a construction system (e.g., how utilities and roads are extended into a parcel of land when it is developed).

Safety

3. Identify and apply appropriate safety measures when working with construction technologies.

Engineering Practice

4. Distinguish among the different forces acting upon structural components (e.g., tension, compression, shear and torsion).

Use and Maintain

Technological Systems

5. Identify and use a variety of technological tools, equipment, machines, materials and technical processes used in construction technologies to build/construct products or systems.

6. Employ construction technologies to resolve practical problems (e.g., a shelter for a pet, emergency shelter for disaster victims).

Design Applications

7. Differentiate the factors that affect the design and building of structures (e.g., material availability, zoning laws, the need for riparian buffer, building codes and professional standards).

Benchmark E: Classify, demonstrate, examine and appraise information and communication technologies.

Grade Nine

Technical Careers

1. Describe the careers available in information and communication technological systems and the training needed to pursue them.

Safety

2. Identify and apply appropriate safety measures when working with information and communication technologies (e.g., making sure that power is disconnected before working on the internal parts of a computer and taking proper static safeguards, protection from the effects of electromagnetic radiation).

Use and Maintain Technological Systems

3. Use a variety of information and communication technologies to demonstrate the inputs, processes, and outputs associated with sending and receiving information (e.g., computer and related devices, graphic (technical and communication) media, electronic transmitters and receiving devices, entertainment products, and various other systems).

4. Employ information and communication technologies to resolve practical problems (e.g., providing radio communication at a school function, communicating a school event to the community).

Design Applications

5. Describe the factors that influence the cost of producing technological products and systems in information and communication technologies.

EmergingTechnology

6. Investigate emerging (state-of-the-art) and innovative applications of information and communication technology.

Benchmark F: Classify, demonstrate, examine and appraise medical technologies.

Grade Nine

Technical Careers

1. Appraise the careers available in medical technological systems and the training needed to pursue them.

Safety

2. Identify and apply appropriate safety measures when working with medical technologies.

Design Application

3. Describe how the design process can be used to produce technological products to replace or repair human physical structures (e.g., prostheses, DNA therapy, pacemakers, lasers).

Technology Assessment

4. Examine new sensing technologies being used to diagnose medical

conditions less invasively (e.g., CT-Scan, MRI, MRA).

Emerging Technology

5. Investigate emerging (state-of-the-art) and innovative applications of medical technologies.

Benchmark G: Classify, demonstrate, examine and appraise agricultural and related biotechnologies.

Grade Nine

Technical Careers

1. Evaluate the training required for various careers in agricultural and biotechnology systems (e.g., chemical applicators, farmer, plant biologist, groundskeeper).

System Management

2. Describe how agriculture includes a combination of organizations that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical and other useful products (e.g., individuals, corporations, financial institutions, and local, state and federal governments).

Safety

3. Identify and apply appropriate safety measures when working with agricultural and related biotechnologies.

Emerging Technology

4. Investigate emerging (state-of-the-art) and innovative applications of agricultural and related biotechnologies.