OHIO TECHNOLOGY STANDARDS FOR ONE PAIR OF EYES

GRADES 7-8

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. 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: Analyze information relative to the characteristics of technology and apply in a practical setting.

Grade Seven

Technology Development

1. Describe the factors involved in developing products and systems using technology (e.g., market survey, design, development, prototyping, assessing, producing, quality assurance, marketing).

2. Develop technological solutions to problems.

3. Discuss ways that technology is linked to creativity and innovation.

Grade Eight

Technology Development

1. Design technological solutions to problems generated by individual or collective needs.

2. Interpret the interrelationship between technology, creativity and innovation.

3. Formulate how a demand for a product may be created through marketing and advertising (e.g., marketing personal computers, music and game devices).

4. Apply multiple factors when developing products and systems to solve problems.

Benchmark C: Analyze the relationships among technologies and explore the connections between technology and other fields of study.

Grade Seven

Technology Interaction

1. Describe the situational interdependence of technologies (e.g., space shuttle crew depends on communication technologies in order to maneuver the craft).

2. Identify products that have been applied to alternative settings.

3. Explain how knowledge from other fields of study may impact the development of technological systems and products.

Grade Eight

Technology Interaction

1. Demonstrate ways that technological systems interrelate.

2. Suggest products that could be used in an alternative setting.

3. Explain ways that invention and innovation within one field can transfer into other areas of technology.

4. Cite examples of how transferred knowledge has impacted the development of technological systems and products (e.g., 1805 Jacquard weaving loom punch card system influenced development of 1950s computer punch card systems).

5. Describe and cite examples illustrating how different technologies require different processes.

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 and 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: Analyze technologically responsible citizenship.

Grade Seven

Technology and Citizenship

1. Classify how new technologies have resulted from the demands, values and interests of individuals, businesses, industries and societies.

2. Relate ways that the uses of inventions and innovations have led to changes in society and the creation of new needs and wants.

3. Identify how societal expectations drive the acceptance and use of products and systems (e.g., impact of the automobile in Ohio 1891 to the present).

Grade Eight

Technology and Citizenship

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

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

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 C: Describe how design and invention have influenced technology throughout history.

Grade Seven

Technology and History

1. Explain how the design and construction of structures for service or convenience have evolved from the development of techniques for measurement, controlling systems, and the understanding of spatial relationships.

2. Analyze a design or invention and explain its historical importance (e.g., 1735 invention of a timepiece that English ships used to accurately navigate longitude position around the world).

Grade Eight

Technology and History

1. Describe how the specialization of function has been at the heart of many technological improvements (e.g., welding: many different processes have been developed to join materials).

2. Examine and compare eras of design in architecture, aviation, transportation, medical instruments and astronomy.

GRADES 9-12

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. 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.

Grade Ten

Technology Diffusion	1. Describe how the rate of technological development and diffusion is increasing rapidly (e.g., a computer system chip has been adapted for use in toys and greeting cards).
Goal-directed Research	2. Articulate how inventions and innovations are results of specific goal-directed research (e.g., companies have research and development offices to guide new product development).
Commercialization of Technology	3. Explain how technological development is influenced by many factors, including profit incentive and market economy.

Grade Eleven

Nature of Technology	1. Articulate and cite examples of how the development of technological knowledge and processes are functions of the setting.
Technology Diffusion	2. Illustrate ways that the rate of technological development and diffusion is exponential.

Goal-directed Research	3. Describe, discuss and cite examples of how goal-directed research results in innovation.
Commercialization of Technology	4. Predict how profit incentive and the market economy influence technological development.

Grade Twelve

Nature of Technology	1. Demonstrate how the development of technological knowledge and processes are functions of the setting.
Technology Diffusion	2. Predict the impact of the exponential development and diffusion of technology.
Goal-directed Research	3. Invent a product using goal-directed research.
Commercialization of Technology	4. Plan/construct technological products considering profit incentive and market economy.

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).

Grade Ten

Technology Transfer	1. Analyze technology transfer scenarios.
Innovation and Invention	2. Describe how technological innovation often results when ideas, knowledge or skills are shared within a technology.
	3. Define examples of how technological progress is integral to the advancement of science, mathematics and other fields of study.

Grade Eleven

Technology Transfer	1. Identify technologies suitable for transfer and defend the rationale for selection.
Innovation and Invention	2. Cite examples of how technological innovation has resulted when ideas, knowledge or skills have been shared within, or among, other technologies.
	3. Illustrate the relationship of technological progress to the advancement of science, mathematics and other fields.

Grade Twelve

Technology Transfer	1. Debate the positive and negative outcomes of technology transfer (e.g.,

given a selected region or country, what types of appropriate technology best meet the needs of the people?).

Innovation and Invention   2. Demonstrate how technological innovation can result when ideas, knowledge or skills are shared within or among technologies or across other fields.

3. Predict changes in society as a result of continued technological progress and defend the rationale.

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 and 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 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.

Grade Ten

Technology and History   1. Examine the social/economic climate for invention and innovation in different periods of history.

2. Explain how the evolution of civilization has been directly affected by, and has affected, the development and use of tools and materials.

Grade Eleven

Technology and History   1. Compare and contrast periods of technology proliferation in the world, and the related social and economic influences.

2. Understand the basic elements of the evolution of technological tools and systems throughout history.

Grade Twelve

Technology and History   1. Debate the position that technology has been a powerful force in reshaping the social, cultural, political and economic landscape, citing references and examples.

Standard 4: Technology and Communication Applications

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.

Grade Nine

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.

Grade Ten

Electronic Communications	1. Identify and incorporate common organizational techniques used in electronic communication (e.g., cause and effect, compare and contrast, problem and solution strategies).
Principles of Design	2. Manipulate communication design elements (image, language, sound and motion) based on intent of the message (e.g., inform or persuade).
Accessibility Guidelines	3. Verify accessibility components of the communication product and adapt as needed.
Evaluation	4. Compare and contrast the accuracy of the message/communication product with the audience results (e.g., was the audience influenced by inaccurate information?).

Grade Eleven

Principles of Design	1. Employ design techniques taking into consideration the psychological impact and cultural connotations of color when designing for print media and multimedia, video and Web pages.
	2. Apply principles of design (contrast, repetition, alignment and proximity) for academic and personal needs (e.g., resume, scholarship application).
	3. Adapt design concepts to emerging technologies.

Evaluation	4. Select and evaluate message-appropriate designs for print, multimedia, video and Web pages for curricular and personal needs (e.g., silly graphics may not be appropriate for academic projects).

Grade Twelve

Principles of Design	1. Facilitate message intent by incorporating design elements that contribute to the effectiveness of a specific communication medium into student-generated products (e.g., black and white footage to imply documented truth; set design that suggests cultural context).
Evaluation	2. Analyze the complexities and discrepancies found in communication products.
	3. Interpret ethical considerations and legal requirements involved in construction of communication products.

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 videoconferencing, 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.

Grade Ten

Use of Communications	1. Contribute to organized e-mail discussions (e.g., discussion list, list serv, threaded discussion list, courseware discussion).
	2. Employ online communication capabilities to make inquiries, do research and disseminate results (e.g., develop dialogues on issues in U.S. government).
	3. Implement online-structured learning experiences (e.g., tutorials, virtual classes, industry certification courses).

Grade Eleven

Use of Communications	1. Select an appropriate e-mail discussion list to meet communication needs (e.g., purpose of list, participants, audience, topics, ease of use).

2. Integrate online communication capabilities to make inquiries, do research and disseminate results (e.g., group writing projects, college searches, career information inquiry).

3. Collaborate in online learning or videoconferencing activities based on research and/or an investigation of real-world problems (e.g., study of community or regional ecosystem).

4. Select and use appropriate online structured learning experiences to meet individual learning needs.

Grade Twelve

Use of Communications

1. Communicate using all manifestations of e-mail, as needed, for personal and curricular purposes, demonstrating appropriate and responsible use.

2. Use all available online communication capabilities to make inquiries, do research and disseminate results.

Evaluation

3. Research emerging communication technologies (e.g., wireless systems, open source software and systems, virtual reality).

Standard 6: Design

Students 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 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 laws 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.

Grade Ten

Design Process	1. Solve an inventive problem that contains a technical contradiction (e.g., analyze the technical system, state the technical contradiction and resolve the technical contradiction).
	2. Apply common statistical tools to solve problems (e.g., statistical process control).
	3. Describe quality and how it is evaluated in a product or system.
	4. Select and use simulation in the design process.
Technical Contradictions	5. Apply 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	6. Discuss how requirements of a design, such as criteria, constraints and efficiency, sometimes compete with each other.
Optimization and Trade-offs	7. Identify criteria and constraints for a design problem and determine how they will affect the design process (e.g., factors such as concept generation, development, production, marketing, fiscal matters, use, and disposability of a product or system).
Technology Transfer	8. Understand the role of outsourcing in the engineering process and how effective communication is essential.
History of Design	9. Describe several systems archetypes and how they explain the behavior of systems.

Intellectual Property	10.Describe how trademarks, patents and copyrights are obtained.

Grade Eleven

Design Process	1. Explain how a design needs to be continually checked and critiqued, and must be redefined and improved (e.g., the heating system design for one home may not be the best for another, given a different location, shape or size).
	2. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product (e.g., proposed or existing designs in the real world).
	3. Interpret plans, diagrams and working drawings in the construction of a prototype.
Technical Contradictions	4. Identify how contradictions were overcome in existing solutions.
	5. Identify products that illustrate application of the 40 principles of technical innovation (e.g., thermal expansion—bimetal thermometer needle, changing color—visual contrast for emergency vehicles, pneumatic or hydraulic construction, automotive—automobile air bag).
Universal Design	6. Employ Universal Design considerations in the design of a product or system (e.g., design a shower or computer workstation for use by people with and without physical handicaps).
	7. Evaluate and rate the quality of an existing household product or system.
Optimization and Trade-offs	8. Explain and demonstrate how constraints influence the solution of problems (e.g., funding, space, materials, human capabilities, time, and the environment).
History of Design	9. Identify a system archetype in an existing system (e.g., styles of design, architecture, design periods, methods).
Intellectual Property	10.Predict the outcome if no copyright or patent laws were in place.
Understanding Technological Systems	11.Explain and use appropriate design processes and techniques to develop or improve products or services in one of the technological systems energy and power, transportation, manufacturing, construction, information and communication, medical, and agricultural and related biotechnologies).

Grade Twelve

Design Process

1. Implement the design process: defining a problem; brainstorming, researching and generating ideas; identifying criteria and specifying constraints; exploring possibilities; selecting an approach, developing a design proposal; making a model or prototype; testing and evaluating the design using specifications; refining the design; creating or making it; communicating processes and results; and implement and electronically document the design process.

2. Evaluate a design solution using conceptual, physical, 3-D computer and mathematical models at various intervals of the design process in order to check for proper design and note areas where improvements are needed (e.g., check the design solutions against criteria and constraints).

Technical Contradictions

3. Apply the separation principles to overcome contradictions in systems (e.g., time, space, combining or dividing systems, physical-chemical changes).

Technical Problem-solving

4. Apply the concepts of system dynamics and systems thinking to the solution of problems.

Technical Communication

5. Evaluate final solutions and communicate observations, processes and results of the entire design process using verbal, graphic, quantitative, virtual and written means, in addition to three-dimensional models.

6. Summarize to another person the enjoyment and gratification of designing/creating/producing a completed illustration, drawing, project, product or system.

Intellectual Property

7. Predict/project the need for changes in copyright, patent and trademark laws, considering the rapid changes in technology and society.

Understanding Technological Systems

8. Apply and evaluate appropriate design processes and techniques to develop or improve products or services in one of the technological systems (manufacturing, construction, information and communication, energy and power, transportation, medical, and agricultural and related biotechnologies).

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).

Grade Ten

Design Process

1. Build a prototype to test a design concept and make actual observations and necessary design adjustments.

2. Design a prototype using quality control measures (e.g., measuring, checking, testing, feedback).

Quality Design

3. Evaluate a design using established design principles to collect data on the design's effectiveness, and suggest improvements (e.g., how can bicycles be made safer?).

4. Explain how established design principles are used to evaluate existing designs, collect data and guide the design process.

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

6. Explain how gender-bias, racial-bias and other forms of stereotyping and discrimination can affect communication within an engineering team.

Engineering Practice

7. Identify where statistical tools might be used to identify problems in a system.

Technical Communication

8. Use multimedia to communicate a design solution between technological systems.

Grade Eleven

Quality Design

1. Evaluate a design completed or created by another group of students using established design principles.

2. Describe the relationship between engineering disciplines.

3. Describe how a prototype is a working model used to show how subsystems interact.

4. Understand that a prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

Design Team Collaboration

5. Collaborate with peers and experts to develop a solution to a specific problem.

6. Demonstrate the importance of teamwork, leadership, integrity, honesty, work habits and organizational skills in the design process.

Technical Contradictions

7. Describe how to identify conflicts or contradictions in technological systems.

Technical Careers

8. Understand the professional and legal responsibilities associated with being an engineer.

Grade Twelve

Design Process

1. Solve a problem as a group with students each taking a specific engineering role (e.g., design a light rail hub with students taking the roles of architect, civil engineer, mechanical engineer).

2. Build a prototype to use as a working model to demonstrate a design's effectiveness to potential customers.

Quality Design	3. Develop and use a process to evaluate and rate several design solutions to the same problem.
	4. Apply statistical tools to identify a problem in a system (e.g., measures of central tendency, linear regression, symbolic logic, non-decimal number systems).
Engineering Design	5. Explain how the process of engineering design takes into account a number of factors including the inter-relationship between systems.
Technical Communcation	6. Choose the appropriate media to communicate elements of the design process in each technological system.

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

<u>Grade Nine</u>

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

<u>Grade Ten</u>

Technical Problem-solving	1. Explain why technological problems must be researched before they can be solved.
Redesign	2. Research previous solutions to a technological problem and redesign an alternative solution.
Emerging Technology	3. Select and apply emerging technology in consultation with experts, for research, information analysis, problem-solving and decision-making in content learning.

Innovation and Invention	4. Categorize inventions in each of the technological systems as one of the five levels of innovation (e.g., apparent or conventional solution, small invention inside paradigm, substantial invention inside technology, invention outside technology, discovery).
Technical Communication	5. Use computers, calculators, instruments and devices to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate to group members (e.g., CAD— computer-aided design, software, library resources, the Internet, word processing, CBLs—calculator based labs, laser measuring tools and spreadsheet software).

Grade Eleven

Quality Design	1. Recognize identify, and apply the concept of function to the solution of technological problems.
Universal Design	2. Apply anthropometric data to judge functional use of a product or design for persons of varying dimensions (e.g., standardized human factors, data charts organized by percentiles).
Reverse Engineering	3. Describe and demonstrate the reverse engineering process in problem- solving.
Technical Communication	4. Use and maintain technical drawing/design tools in order to create a variety of drawings and illustrations (e.g., instruments, equipment, materials, computer-aided design software, hardware and systems).

Grade Twelve

Design Team Collaboration	1. Explain why technological problems benefit from a multidisciplinary approach (e.g., the research and development of a new video game could benefit from knowledge of physiology—reaction times and hand-eye coordination, as well as psychology—attention span, color theory and memory).
Links to Other Fields	2. List the disciplines that could contribute to a solution of a specific problem.

Reverse Engineering   3. Apply and evaluate the reverse engineering process in problem- solving.

http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?page=3&TopicRelationID=1707 &ContentID=1279&Content=51505