Technology Alignment of Benchmarks and Indicators
GRADE 11

<u>**Standard 1 Nature of Technology**</u>

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 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.

Benchmark B: Apply technological knowledge in decision-making.

Grade Eleven

Optimization and Trade-offs

1. Cite examples showing how the failure of system components contributes to the instability of a technological system (e.g., if the fuel pump in an automobile malfunctions, the entire system will not work properly; or if a computer hard drive fails, the computer system will not work properly).

Sustainability

2. Discuss how sustainability is a balance of economic prosperity, environmental quality and social equity.

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

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.

<u>Standard 2 Technology and Society Interaction</u>
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 Eleven
Technology and Citizenship
1. Assess technology systems, resources and services relative to responsible usage of technology.
2. Describe how changes caused by the use of technology can range from gradual to rapid, and from subtle to obvious.
3. Compare and evaluate the advantages and disadvantages of widespread use and reliance on technology in the work place and in society as a whole.
4. Analyze the causes, consequences and possible technology solutions to problems in a persistent, contemporary and emerging world (e.g., health, security, resource allocation, economic development or environmental quality).
5. Examine the ethical considerations of a governmental technology policy that affects the physical characteristics of a place or region (e.g., building of the oil pipeline in Alaska, mineral rights under farmland).
6. Compare and evaluate alternate public policies for technology deployment and the use of natural resources.
Benchmark B: Demonstrate the relationship among people, technology and

the environment.
Grade Eleven
Technology and Environment
1. Understand that humans can devise technologies to conserve water, soil and energy through such techniques as reusing, reducing and recycling.
2. Demonstrate how technological decisions involve trade-offs between predicted positive and negative effects on the environment.
Benchmark C: Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.
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.
Benchmark D: Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.
Grade Eleven
Technology and Ethics
1. Debate the ethical considerations involved in the development or deployment of new technologies (e.g., medical technologies to create or extend life, satellite imagery, software to capture content or monitor user activity).
2. Examine and discuss how technology, its use and resultant societal changes are viewed by different ethnic, cultural and religious groups.
3. Evaluate access (expanded and limited) determined by technology, law, legislation and/or policy.
Benchmark E: Forecast the impact of technological products and systems.
Grade Eleven
Technology Assessment
1. Use assessment techniques, such as trend analysis and experimentation to make decisions about the future development of technology.
2. Locate and evaluate past predictions about the development of technology.
3. Describe techniques for making decisions about the future development of technology.

Standard 3 Technology for Productivity Applications
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 Eleven

Understanding Operations

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

2. Explore state-of-the-art devices to store data.

Problem-solving

3. Research technology systems, resources and services to solve technical problems.

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

Grade Eleven

Knowledge Generation

1. Apply emerging technology tools and resources for managing and communicating personal/professional information (e.g., distance-learning, voice-recognition tools, personal digital devices, automatic identification systems, bar codes, radio frequency tags).

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 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 andWeb pages for curricular and personal needs (e.g., silly graphics may not be appropriate for academic projects).

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

Grade Eleven

Electronic Communications

1. Archive communication products in appropriate electronic forms (e.g., store electronic publications so that they may be accessed when needed).

Evaluation

2. Critique personal 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 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 video-conferencing 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.

Standard 5 Technology and Information Literacy

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 Eleven

Evaluating Sources

1. Seek and evaluate information to answer both personal and curricular needs.

2. Analyze the intent and authorship of information sources used for a

curricular need.

3. Determine valid information for an assignment from a variety of sources.

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

Grade Eleven

Decide

1. Select essential questions for research and use a recognized or personally developed model to conduct independent research.

Find

2. Identify, evaluate information and select relevant and pertinent information found in each source.

3. Identify relevant facts, check for validity, and record appropriate information keeping track of all sources.

Use

4. Analyze information and synthesize into a communicated product.

5. Respect copyright laws and guidelines, and use standard bibliographic format to list sources.

Check

6. Critique and revise the information product.

7. Review the research process for efficiency and effectiveness.

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 Eleven

Search Strategies

1. Demonstrate the use of parentheses for nesting search terms to alter retrieval strategies through multiple Internet resources.

2. Create a product on a specific curricular topic that includes annotated Web sites constructed according to a standard style manual (e.g., electronic pathfinder on careers).

Evaluating Sources

3. Develop a systematic approach to judge the value of the retrieved Web information.

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

Grade Eleven

Electronic Resources

1. Modify a search through the use of different key words and other techniques specific to an electronic resource (e.g., online database,Web-based index).

2. Integrate online subscription resources and other electronic media to meet needs for research and communication on a routine basis.

3. Differentiate coverage of electronic resources to select information need.

4. Support choices of free and fee-based Web information used to create a

class project.

<u>**Standard 6 Design**</u>
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 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).

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

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.

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.

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

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).

<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 Eleven
System Management
1. Classify energy-using devices and systems into the major forms: thermal, radiant, electrical, mechanical, chemical, nuclear and acoustic.
Engineering Practice
2. Identify and explain sources of resistance (e.g., 45o elbow, 90o elbow, type of pipes, changes in diameter; for water moving through a pipe).
3. Use series circuit and a parallel circuit to modify the voltage and current available from a group of batteries.
Use and Maintain Technological Systems
4. Build and operate a transportation device (e.g., a magnetic levitation vehicle, a CO2 car, wind vehicle).

5. Identify and explain the tools, controls, and properties of materials used in a thermal system (e.g., thermostats, R Values, thermal conductivity, temperature sensors).

6. Describe the differing power quality needs of end users (e.g., uninterruptability, backup generators, frequency and voltage stability).

7. Explain and demonstrate series and parallel circuit usage in residential wiring.

8. Diagnose a system that is malfunctioning and use tools, materials, machines and knowledge to repair it (e.g., digital meters or computer utility diagnostic tools).

Technology Assessment

9. Evaluate different types of energy sources for personal transportation (e.g., cleaner fuels like biodiesel, electricity, hybrid electric, ethanol, natural gas—CNG, LNG, propane—LPG, hydrogen).

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

Grade Eleven

System Management

1. Define intermodalism as the use of different modes of transportation, such as highways, railways and waterways as part of an interconnected system that can move people and goods easily from one mode to another.

Emerging Technology

2. Investigate emerging (state-of-the-art) and innovative applications of transportation technology.

Benchmark C: Classify demonstrate examine and appraise manufacturing technologies.

Grade Eleven

Technical Communication

1. Document processes and procedures using appropriate oral and written techniques (e.g., flow charts, drawings, graphics, symbols, spreadsheets, graphs, Gantt charts and World Wide Web pages).

System Management

2. Describe the factors that influence the cost of producing technological products and systems in manufacturing technologies (e.g., materials, labor, energy, time, location).

Safety

3. Differentiate the selection of tools and procedures used in the safe production of products in the manufacturing process (e.g., hand tools, power tools, computer-aided manufacturing, three-dimensional modeling).

Engineering Practice

4. Calculate the mean, median, mode and standard deviation for a set of data and apply that information to an understanding of quality assurance.

Use and Maintain Technological Systems

5. Demonstrate product and system maintenance and service technique (e.g., installing, diagnosing, troubleshooting, recalling, maintaining,

repairing, altering and upgrading, and retrofitting).

6. Describe how durable goods are designed to operate for a long period of time, while nondurable goods are designed to operate for a short period of time (e.g., durable goods: steel, furniture, washing machines; nondurable goods: food, batteries, paper).

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

Grade Eleven

Technical Communication

1. Apply appropriate technical and graphic communications in the technological systems (e.g., linedrawing, phantom view, rendering, animation, simulation, virtual walk-through).

Use and Maintain Technological Systems

2. Determine the need for maintenance, alteration or renovation in a structure (e.g., determine when is a new roof needed, calculate the cost benefit of purchasing more energy efficient windows).

3. Describe how structures are constructed using a variety of processes and procedures (e.g., welds, bolts and rivets are used to assemble metal framing materials).

Design Applications

4. Describe the factors that influence the selection of technological products and systems in construction technologies (e.g., function, cost, aesthetics).

Emerging Technology

5. Investigate emerging (state-of-the-art) and innovative applications of construction technology (e.g., carbon-fiberglass strips used to reinforce old beams and in making trusses that are stronger than steel).

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

Grade Eleven

Use and Maintain Technological Systems

1. Use information and communication systems to cause the transfer of information from human to human, human to machine, machine to human, and machine to machine (e.g., two people talking to each other on the phone; a person inputting data in a computer using a keyboard; an electric fax machine providing a copy of a message to a person; and an automated system transferring financial records from one bank computer to another bank computer).

2. Analyze communication systems and identify the source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination (e.g., telephone, TV, newspaper).

3. Explain how information travels through different media (e.g., electrical wire, optical fiber, air, space).

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

Grade Eleven
Technical Careers
1. List advances in the sciences of biochemistry and molecular biology that have made it possible to manipulate the genetic information found in living creatures.
2. Describe how medicines and treatments may have both expected and unexpected results.
Safety
3. Monitor and apply appropriate safety measures when working with medical technologies.
Use and Maintain Technological Systems
4. Employ medical technologies to resolve practical problems (e.g., choose an appropriate bandage for an injury, contact the appropriate service provider in an emergency).
Emerging Technology
5. Investigate and evaluate new medical technologies.
Benchmark G: Classify, demonstrate, examine and appraise agricultural and related biotechnologies.
Grade Eleven
System Management
1. List biotechnology applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment and genetic engineering (e.g., fermentation, bio-products, microbial applications, separation and purification techniques, genetically modified seeds, modified organisms, algal fertilizers).
Use and Maintain Technological Systems
2. Employ agricultural and biotechnologies to resolve practical problems (e.g., growing food year-round, using plants to eliminate erosion).
Technology Assessment
3. Consult with experts and determine the effect of emerging biotechnologies on the job market (e.g., compare and contrast the amount of produce at a local produce distribution center grown hydroponically and traditionally).