foreign languages

science

English language arts

the arts

social studies

$y=mx+b$

technology

mathematics

K-12 Technology

Alignment of Benchmarks and Indicators by Grade Band

ACADEMIC CONTENT STANDARDS

Grades K-2

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: Recognize the characteristics and scope of technology.

Kindergarten

Technology Characteristics
1. Identify objects created within the human-made world (e.g., books, chairs, houses, buses) and objects that occur in nature (e.g., trees, flowers, rocks and rivers).

2. Describe how people use tools to help them do things.

Grade One

Technology Characteristics
1. Distinguish between the natural and human-made world (e.g., a forest vs. a city skyline).

2. Cite examples of how people use tools and processes to perform tasks.

Grade Two

Technology Characteristics
1. Contrast between characteristics that separate natural processes and human-made designed world (e.g., appearance, structure, material).

2. Describe and give examples of how people use tools and processes to solve problems (e.g., using a knife to make a peanut butter sandwich, or using a measuring cup while following a recipe to make a cake).

3. Recall common terms, facts and basic concepts relative to technology (e.g., types of computer equipment, devices by purpose).

Benchmark B: Describe and give examples of technology's core concepts: systems, resources and processes.

Kindergarten

Systems   1. Identify common systems in the school or home (e.g., the plumbing system delivers water to and from your bathtub).

Processes   2. Recall that planning is necessary to successfully complete a task.

Grade One

Systems   1. Identify and describe a technological system.

Processes   2. Identify and demonstrate processes necessary to complete a task.

Grade Two

Systems   1. Identify and explain that systems have parts or components such as processes and controls that work together to accomplish a goal (e.g., to heat food in a microwave oven, electricity is generated and transmitted, temperature and cook time is controlled).

                     2. Identify the various component parts of familiar systems and articulate the goals that are accomplished with them (e.g., in a plumbing system, pipes deliver water, the faucet controls the flow).

Processes   3. Describe, identify and demonstrate appropriate systematic planning strategies in order to complete a task (e.g., steps required to bake cookies, how to complete a class project).

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

Kindergarten

Technology Devices 1. Identify technology devices in the classroom (e.g., bells, computer, fire alarm, pencil sharpener).

Connections   2. Recognize the connection between technology and other fields of study (e.g., technology can be used to make or create music or musical instruments).

Grade One

Technology Devices 1. Identify school-wide technology devices (e.g., office public address system, library-automated book check-out, auditorium audio-visual system, electronic lunch purchase).

Connections

2. Describe the connections between technology and other fields of study (e.g., teachers use computers, scientists use microscopes, farmers use tractors).

Grade Two

Connections

1. Describe how problems lead to invention and innovation (e.g., the invention and development of earmuffs).

2. Explore the use of technology in different fields of study (e.g., school subjects, careers and technologies common to them).

Grades K-2

> **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: Identify responsible citizenship relative to technology and its use.

Kindergarten

Technology and Citizenship

1. Describe how the use of tools and machines can be helpful or harmful.

Grade One

Technology and Citizenship

1. Identify tools and machines that can be helpful and/or harmful.
2. Describe the reasons for making products (e.g., to meet needs and wants).

Grade Two

Technology and Citizenship

1. Discuss how making products meets our needs and wants.
2. Give examples of how the use of tools and machines can be helpful and/or harmful.

Benchmark B: Recognize that technology has an interrelationship with the environment.

Kindergarten

Technology and the Environment

1. Explain how waste results from making and using things, and/or discarding them.
2. Identify materials that can be reused and/or recycled.

Grade One

Technology and the Environment

1. Explain how various materials can be reused or recycled.

2. Describe the reasons for doing things or behaving in ways that protect the environment.

Grade Two

Technology and the Environment

1. Explain ways communities can manage waste to keep people safe.

2. Classify and differentiate among materials that can be reused and/or recycled (e.g., paper can be recycled to make new products).

Benchmark C: Describe and demonstrate how technology has had an influence on our world.

Kindergarten

Technology and History

1. Recognize that technology changes the way people live and work.

Grade One

Technology and History

1. Describe or list ways technology has changed the way people lived and worked throughout history (e.g., grandparents' era to today).

Grade Two

Technology and History

1. Demonstrate and give examples of how technology has changed the way people lived and worked throughout history.

Benchmark D: Collect information about products and discuss whether solutions create positive or negative results.

Kindergarten

Technology Assessment

1. Collect information about products and systems used at home by asking questions (e.g., electronic toothbrush, toaster, TV).

2. Describe how a product or system can be used the right way and the wrong way (e.g., using scissors as a knife, a screwdriver as a can opener).

Grade One

Technology Assessment

1. Collect information about products and systems used at school by asking questions (e.g., books, computers, piano).

2. Describe how the use of a product or system might cause something bad to happen (e.g., running a car causes pollution, cars get into accidents).

Grade Two

Technology Assessment

1. Identify businesses and industries in the community and describe the products or services provided.

2. Determine if the human use of a product or system creates positive or negative results (e.g., large parking lots for cars may cause water run-off problems).

ACADEMIC CONTENT STANDARDS

Grades K-2

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: Understand basic computer and multimedia technology concepts and terminology.

Kindergarten

Basic Concepts
1. Locate computer and multimedia technology in the classroom and identify it by name (e.g., computer, VCR, listening station).

2. Name the basic parts of a computer (e.g., monitor, keyboard, mouse, printer).

3. Use computer and multimedia technology with teacher assistance (e.g., computer, VCR, listening station).

Grade One

Basic Concepts
1. Identify and use computer and multimedia technology and know the terms used to describe it (e.g., computer, printer, VCR, DVD player, audio players).

2. Identify various parts of a computer by name (e.g., monitor, mouse, keyboard, power button, disk drive, CD/DVD drive).

Grade Two

Basic Concepts
1. Identify and describe the purpose of various types of computer and multimedia technology (e.g., what is it and what does it do?).

2. Use correct terminology when talking about computers and multimedia technology.

Basic Operations
3. Know that software is necessary to operate computer technology.

4. Use a variety of computer and multimedia technology resources for directed learning activities (e.g., computer, VCR/DVD player, audio player, camera).

<hr>

Benchmark B: Demonstrate operation of basic computer and multimedia technology tools.

<hr>

Kindergarten

Responsible Usage	1. Listen to directions and use proper care when handling computer and multimedia technology.
	2. Follow the correct order for turning computers and multimedia technology resources on and off with teacher assistance.
Basic Operations	3. Identify and use input (keyboard, mouse) and output (printer) devices to operate computer and multimedia technology tools with teacher assistance.
	4. Use software programs with teacher assistance.
Problem-solving	5. Discover that technology tools can help solve problems.
Productivity Tools	6. View multimedia presentations and discuss motion and sound.

Grade One

Responsible Usage	1. Discuss and demonstrate proper care when using computer and multimedia technology resources (e.g., describe rules, list directions).
	2. Turn computer and multimedia technology resources on and off.
Basic Operations	3. Discuss software and why it is necessary to operate computer and multimedia technology.
	4. Start, use and exit software programs with teacher assistance.
	5. Use input (keyboard, mouse) and output (printer) devices to operate computer and multimedia technology tools with teacher assistance.
Problem-solving	6. Use software programs designed to develop problem-solving skills.
Beginning Keyboarding	7. Begin to locate letters and special keys on the keyboard with teacher assistance (e.g., enter key, escape key, space bar).

Grade Two

Responsible Usage	1. Demonstrate proper care of computer and multimedia technology resources.
Basic Operations	2. Identify and use input and output devices to operate and interact with computers and multimedia technology resources (e.g., scanner, digital camera, video camera).
Problem-solving	3. Demonstrate problem-solving skills within a software application.
Productivity Tools	4. Develop a slide show presentation with teacher assistance (e.g., small groups work together to create slides or hypermedia products).

Beginning Keyboarding

5. Use proper keyboarding techniques (e.g., placing their fingers on home row keys).

Benchmark C: Use productivity tools to produce creative works.

Kindergarten

Productivity Tools

1. Recognize productivity tools (e.g., presentations, drawing programs).

Research Tools

2. Identify/recognize technology resources (e.g., pre-selected Web sites, educational software).

Grade One

Productivity Tools

1. Describe how productivity tools are used to create documents, presentations and drawings.

Research Tools

2. Use technology resources with teacher assistance (e.g., pre-selected Web sites, launching applications, educational software).

Grade Two

Productivity Tools

1. Use productivity tools with teacher assistance (e.g., word processing, presentations, drawing programs).

Research Tools

2. Use technology resources with teacher assistance for communication and illustration of thoughts and ideas (e.g., creative stories, drawings, presentations, publication software).

Grades K-2

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: Investigate the nature and operation of communication systems.

Kindergarten

Media Formats

1. Explore different types of media formats used to communicate information (e.g., e-mail, TV, newspapers, film, phones, Web pages).

Grade One

Media Formats

1. Explain media formats used to communicate information (e.g., e-mail, newsletters, TV, phones, newspapers, Web pages).

2. Show, within a group, various types of communication formats used in everyday life.

Grade Two

Media Formats

1. Use media to view information.

2. Participate in the creation of media products (e.g., use appropriate communication tools with teacher assistance).

Benchmark B: Explore how information can be published and presented in different formats.

Kindergarten

Productivity Tools

1. Examine digital images in learning (e.g., students select pictures of community helpers from teacher-identified materials).

Grade One

Productivity Tools

1. Create documents with teacher assistance (e.g., students observe the teacher making a document, they add ideas, and select images for the teacher to import).

Communication Tools	2. Identify and explore different forms of electronic communication (e.g., written documents in electronic form, e-mail, Web pages, video, multimedia).

Grade Two

Productivity Tools	1. Use graphic organizers to plan a presentation (e.g., graphic organizing, charting or mapping software).
	2. Compare digital graphic images used to portray a topic (e.g., students are given images on the same topic from two different sources and explain why one may be better for the assignment than another).
Communication Tools	3. Present information in an electronic format, including text, graphics or multimedia (e.g., write and illustrate a story based on writing prompt, slide show or photo album).
	4. Compose class e-mail (e.g., each student has an opportunity to contribute ideas for e-mail messages related to their studies).

Benchmark C: Participate in group projects and learning activities using technology communications.

Kindergarten

Use of Communications	1. Engage in teacher-directed online learning activities (e.g., 100th day of kindergarten activities, online field trips).

Grade One

Use of Communications	1. Contribute to teacher-directed online projects (e.g., collecting weather data, listing of bird counts).

Grade Two

Use of Communications	1. Use e-mail to share information in a teacher-directed group e-mail activity (e.g., comparing class information with another class at a remote location).
	2. Participate in communication sessions (e.g., e-mail, videoconferencing, phones, interact with other classes in teacher-directed online project).

Grades K-2

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: State what information is, and show where it can be found.

Kindergarten

Understanding Information
1. Identify what information is and recognize that it can be represented in a variety of ways (e.g., numbers, words, pictures, sounds).
2. Identify places where information can be found and retrieve information from a specified location (e.g., classroom, school library, public library, the Internet, computer folder, hard drive, Web site, book).

Grade One

Understanding Information
1. Talk about the difference between factual information and fiction (e.g., what is real and what is pretend or make-believe).
2. Use a graphic organizer to sort information.

Grade Two

Understanding Information
1. Tell about the purposes for information use (e.g., information is helpful to solve problems, find answers, learn).
2. Distinguish between fact and fiction (e.g., discuss and compare a fact-based document about a topic with a story about the same topic).

Benchmark B: Use a simple research process model which includes deciding what to use, finding resources, using information and checking work to generate a product.

Kindergarten

Decide
1. Ask questions about an identified topic.

Find

2. View information in an information source selected by the teacher or librarian.

Use

3. Tell what was learned using technology tools (e.g., use a computer drawing/paint program to draw a picture that explains what was learned).

Grade One

Decide

1. Ask questions about an identified topic and list facts already known about the topic (e.g., graphic organizers for brainstorming, charting, webbing).

Find

2. Find information in a technology-based resource (e.g., Web site, database, DVD, software program, video).

Use

3. Use technology to tell what was learned from information gathered (e.g., use simple presentation tools to create a poster, book, slide show).

Check

4. Tell where information came from (e.g., name of Web sites, software, databases).

Grade Two

Decide

1. Discuss the question assigned by the teacher and where the information might be found.

Find

2. Use the online library catalog to locate information sources by title, author or subject.

3. Select needed information from teacher-selected Web sites, electronic encyclopedias and other electronic collections.

Use

4. Record and organize information to generate a product.

5. Give credit to the sources used for work by listing the author and the name of the source.

Check

6. Tell how information was found.

Benchmark C: Apply basic browser and navigation skills to find information from the Internet.

Kindergarten

Internet Concepts

1. Talk about the Internet as an information source.

2. Use Web page functions:

    a.   Scroll up and down page;
    b.   Click on links; and
    c.   Use back button.

ACADEMIC CONTENT STANDARDS

Grade One

Internet Concepts

1. List types of information available on the Internet (e.g., school Web site, local information, animals, maps).

2. Use teacher or librarian selected Web site to find information or learn new things.

3. Use browser tools and buttons:
   a.   Forward and back button;
   b.   Home button;
   c.   Choose a link from the bookmarks or favorites list.

Grade Two

Internet Concepts

1. Demonstrate the use of browser elements including the toolbar, buttons, favorites or bookmarks, and tell their function.

2. Search for information in an online encyclopedia using a topical search (e.g., choose from a list of topics, moving from broad—animals, to more specific—panda).

3. Read information from a Web site assigned by teacher and identify the name and topic of the Web site.

ACADEMIC CONTENT STANDARDS

Grades K-2

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 problems and potential technological solutions.

Kindergarten

Technical Problem-solving

1. Identify problems solved by tools (e.g., list tools and describe the problem that they solve such as crayons—communication, coats—protection from elements, clocks—time, toothbrush—cavities).

Grade One

Technical Problem-solving

1. Identify possible solutions to a problem.

2. Distinguish the difference between people's needs and wants and how this can influence potential solutions.

Strength and Materials

3. Identify and describe characteristics of different materials used to create technological products that provide solutions (e.g., wood, metal, glass, plastic).

Grade Two

Technical Problem-solving

1. Describe how experience has helped in solving a new problem (e.g., painting skills can be applied to different materials and similarities in software program operation).

2. Brainstorm multiple solutions to problems to be solved by the design process (e.g., how to transport a piece of paper in order to turn in an assignment across the classroom).

3. Plan, construct and evaluate a model to test a problem's solution (e.g., to harness wind energy, build a model windmill).

Innovation and Invention	4. Demonstrate how design is a creative process (e.g., each student brings in an old, pre-owned toothbrush and looks at the differences).

Benchmark B: Understand that changes in design can be used to strengthen or improve an object.

Kindergarten

Strength and Materials	1. Make observations of how things are made strong (e.g., using more of the same material).

Grade One

Strength and Materials	1. Recognize that designs have limited strength (e.g., a toy bridge made of craft sticks can support only so much weight).
	2. List the materials used in common items (e.g., house, car, toys).
Design Process	3. Describe how things are built by thinking of an idea, trying out a design and sharing it with others.
Technical Communication	4. Understand we can draw things and then have someone else build them.

Grade Two

Strength and Materials	1. Describe a situation where a technology failed because it was not strong enough (e.g., a bike, wagon or swing that was broken when too much weight was on it).
	2. Recognize that when weaker materials are combined together they become stronger (e.g., one thread is easy to break, but combined into a rope they are strong).
Design Process	3. Distinguish the engineering design process elements of identifying a problem, looking for ideas, developing solutions and sharing solutions with others.
Technical Communication	4. Describe why expressing ideas to others verbally and through sketches and models is an important part of the design process (e.g., provides opportunity to test ideas, better plan the work, and organize needed tools and materials).

Benchmark C: Explore how products are invented and repaired.

Kindergarten

Technical Problem-solving	1. Ask questions and make observations about how things work (e.g., take a mystery device and ask questions to determine what it does).

Technical Communication	2. Communicate information about a product (e.g., describe a favorite toy and how to use it).

Grade One

Technical Problem-solving	1. Understand that things break but can often be fixed (e.g., have students share their experiences).
	2. Describe how to repair a broken toy (e.g., make sure the switch is on, the batteries are charged and nothing is blocking the toy's operation).

Grade Two

Technical Problem-solving	1. List steps to follow to test something that has malfunctioned (e.g., steps followed to check a computer, radio or game player that is not working properly).
Design Process	2. Describe something that you think should be invented (e.g., an airplane kids can pilot, a doll that can jump rope).
Inventors/Inventions	3. Identify famous inventors and products available today based on their inventions.

A C A D E M I C   C O N T E N T   S T A N D A R D S

Grades K-2

Standard 7: Designed World

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 and agricultural and related biotechnologies.

Benchmark A: Develop an understanding of the goals in physical technologies.

Kindergarten

Energy and Power
1. List the things around the home that use energy (e.g., TV, stove, washing machine, computer).

2. List different energy sources that we use (e.g., electricity, coal, gasoline).

Transportation
3. Know that a transportation system has many parts that work together to help people travel (e.g., driver, mechanic, police, road repair crews).

Manufacturing
4. Name products that are manufactured (e.g., toys, cars, furniture).

Construction
5. Describe different types of buildings (e.g., houses, apartments, office buildings and schools).

Grade One

Energy and Power
1. List the various forms of energy that are used in the community (e.g., electrical, mechanical, thermal).

2. List the kinds of energy we can purchase (e.g., batteries, gas, electricity).

Transportation	3. Understand that vehicles move people or goods from one place to another in water, air or space and on land (e.g., boats, airplanes, rockets, trucks).
Manufacturing	4. Name products that are produced in large quantities (e.g., candy, baseballs, cars).
Construction	5. Name things that are constructed where they are used (e.g., roads, buildings, bridges).

Grade Two

Energy and Power	1. Describe various ways energy can be conserved (e.g., limiting the number of times the refrigerator/freezer doors are opened; not leaving the water running while brushing your teeth).
	2. List job titles that are in the technological system of energy and power technologies (e.g., auto mechanic, electric lineperson, coal miner).
Transportation	3. Understand that transportation vehicles need to be cared for to prolong their use (e.g., scheduled maintenance on cars).
	4. List job titles that are in the technological system of transportation technology (e.g., driver, pilot, captain, attendant, reservations agent).
Manufacturing	5. Explain that manufactured products are designed.
	6. List job titles that are in the technological system of manufacturing technology (e.g., engineer, machinist, repair person, marketer, industrial designer).
Construction	7. Explain how the type of a structure determines how parts are put together (e.g., bricks, lumber, concrete).
	8. List job titles that are in the technological system of construction technology (e.g., carpenter, architect, building inspector, bulldozer operator, plumber).

Benchmark B: Develop an understanding of the goals of informational technologies.

Kindergarten

Information and Communication	1. Explore ways to share ideas (e.g., speaking, drawing, modeling).

Grade One

Information and Communication	1. Use symbols to communicate (e.g., write a sentence using pictures).
	2. Describe how technology enables communication by sending and receiving information (e.g., telephone, TV, magazines, e-mail).

Grade Two

Information and Communication

1. Understand that information is data that has been organized (e.g., make a table of data that has been collected).

2. List job titles that are in the technological system of information and communication technologies (e.g., reporter, camera person, printer, newscaster).

Benchmark C: Develop an understanding of the goals of bio-related technologies.

Kindergarten

Medical

1. Recognize how medicine helps people who are sick to get better.

Agriculture and Related Biotechnologies

2. Describe different tools and equipment you might see on a farm.

Grade One

Medical

1. Know that vaccinations protect people from getting certain diseases.

Agriculture and Related Biotechnologies

2. Explain how the use of technologies in agriculture makes it possible for food to be available year round.

Grade Two

Medical

1. List products designed specifically to help people take care of themselves (e.g., toothbrush, soap, clothing).

2. List job titles that are in the technological system of medical technology (e.g., nurse, doctor, emergency medical technician).

Agriculture and Related Biotechnologies

3. Describe how the use of technologies in agriculture makes it possible to conserve resources (e.g., computer-controlled machinery, equipment and facilities).

4. List job titles that are in the technological system of agricultural and related biotechnologies (e.g., farmer, picker, bottler, scientist and grocer).

Grades 3-5

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: Compare and discuss the characteristics of technology in our community.

Grade Three

Natural or Human-made	1. Describe how things found in nature differ from things that are human-made (e.g., compare animal structures, such as nests and dens, and human-made structures used for shelter).
Tools, Materials, Skills	2. Identify technology in the classroom and discuss its use.
	3. Demonstrate the use of technology in the classroom.
Creating Technology	4. List ways that society/government provides technology benefits for everyone (e.g., bus systems, water and sewage systems and mail delivery).

Grade Four

Natural or Human-made	1. Describe how the processing of things found in nature result in human-made artifacts (e.g., furniture may be made from lumber, which comes from trees).
Tools, Materials, Skills	2. Demonstrate how tools, materials and skills are used to perform tasks (e.g., computers and cell phones are used to communicate; pencil sharpeners).
Creating Technology	3. Describe ways creative thinking, economic and cultural influences shape technological development (e.g., Wright Brothers, powered flight, air commerce).
	4. Recognize that creative thinking, economics and culture influence technological development (e.g., a city may need to design a mass transit

system for transportation while a small town may use personal vehicles).

Grade Five

Natural or Human-made	1. Create a human-made product from natural materials (e.g., process natural materials into new products).
Tools, Materials, Skills	2. Use tools, materials and processes to produce products and carry out tasks efficiently and effectively.
	3. Demonstrate the use of technology in daily life, noting the advantages and disadvantages those uses provide.
Creating Technology	4. List companies or businesses related to each of the seven technological systems (e.g., hospitals, farms, gas stations, radio stations, airlines, toy manufacturers and home builders).

Benchmark B: Identify, describe and discuss the core concepts of technology.

Grade Three

Resources	1. Identify the resources, tools and machines, materials, information, energy, people, capital and time that are needed to complete a task (e.g., digital camera, computer, paper, resource materials, electricity, students, money for notebooks and scheduled lab time).
	2. Describe different properties of materials: color, weight, mass, hardness, temperature.
Processes	3. Describe how tools and machines extend human capabilities such as holding, lifting, carrying, fastening, separating and computing.

Grade Four

Resources	1. Classify materials by property.
Processes	2. Select and use tools to design, make and modify technology.
	3. Cite examples of how tools and machines extend human capabilities (e.g., automobiles are more efficient than walking great distances).

Grade Five

Processes	1. Select and use tools to design, make, modify and assess technology.
	2. Test the properties of materials.
	3. Demonstrate how tools and machines extend human capabilities.
Requirements	4. Recognize that requirements are the limits to designing or making a product or system.

ACADEMIC CONTENT STANDARDS

Benchmark C: Compare and discuss the relationships among technologies, and the connections between technology and other fields of study.

Grade Three

Connections

1. List process examples from each of the seven technological systems (e.g., diagnosing, harvesting, transmitting, printing, flying, welding and building).

2. Understand that each of the seven technological systems have specialized tools and tools in common.

Grade Four

Connections

1. Describe what is needed to cause a technology to develop further in each of the technological systems (e.g., business support and research initiatives).

Grade Five

Connections

1. Compare services provided in each of the seven technological systems and identify specialized tools used in each system.

ACADEMIC CONTENT STANDARDS

Grades 3-5

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: Define responsible citizenship relative to technology.

Grade Three

Technology and Citizenship

1. Discuss how technology may have positive and/or negative consequences.

2. Identify and discuss how products are developed and modified to meet changing individual needs and wants.

Grade Four

Technology and Citizenship

1. Explore and compare common uses of technology in daily life, and the advantages and disadvantages those uses provide.

2. Discuss basic issues related to responsible use of technology and information, and describe personal consequences of inappropriate use.

3. Describe why it is important for everyone to have access to information sources and information technology.

Grade Five

Technology and Citizenship

1. Identify and show cooperative and collaborative strategies to work with others when using technology systems.

2. Analyze common uses of technology in daily life and the advantages and disadvantages those uses provide (e.g., how technology helps us communicate).

3. Distinguish basic issues related to responsible use of technology and information, and relate personal consequences of inappropriate use.

ACADEMIC CONTENT STANDARDS

Benchmark B: Investigate and explain the interrelationships between technology and the environment.

Grade Three

Technology and the Environment   1. Describe how technology affects the environment in positive and/or negative ways.

Grade Four

Technology and the Environment   1. Describe how appropriate management of resources and waste can prevent harm to the environment.

Grade Five

Technology and the Environment   1. Investigate alternative methods for the protection of the environment.

Benchmark C: Explain and demonstrate the influence of technology throughout history.

Grade Three

Technology and History   1. Illustrate ways that people have made tools to provide food, make clothing and provide protection.

2. Explain how technology and invention have changed economic and social development in our community.

Grade Four

Technology and History   1. Describe the advantages that resulted from people making and using tools (e.g., importance of the grist mill, saw mill, carding mill to early Ohio settlements).

Inventors/Inventions   2. Explain the role of Ohio's inventors in the social and economic development of society (e.g., Thomas Edison, the Wright Brothers, Charles F. Bush, Granville T. Woods, Elisha Gray, James W. Packard, Alexander Winton, Frank A. Sieberling, Garrett Morgan, Charles Kettering).

Grade Five

Technology and History   1. Discuss and create alternative solutions to the ways that people have made tools to provide food, make clothing and provide protection.

2. Explain how technology and invention have changed economic and social development.

Standard 2: Technology and Society Interaction

ACADEMIC CONTENT STANDARDS

Benchmark D: Practice responsible use of technology, understand school district guidelines for technology use, and explore technology ownership.

Grade Three

Intellectual Property

1. Work collaboratively with others, respecting their ideas and needs, when using technology.

2. Understand that people use technology to create new items (products, resources, etc.) and that the creator may own the rights to these items (e.g., an author may create a Web site, a programmer may create software, an inventor may create a device).

Acceptable Use

3. Know that the district Acceptable Usage Policy (AUP) describes the rules for using classroom technology and the Internet.

Grade Four

Intellectual Property

1. Practice respect for intellectual property rights (e.g., another student's ideas and acknowledge all contributions to group work).

2. Discuss technology ownership rights, including the concept that the creator of the technology may be the owner, and that users must purchase the right to use the technology (e.g., a company may own rights to products made by its employees).

Acceptable Use

3. Discuss policies presented in the district Acceptable Usage Policy (AUP) and understand that the AUP describes the rules for using school-based technology.

Grade Five

Intellectual Property

1. Discuss patent, copyright, trade name/trademark protection and the rights of the owner of the work (e.g., inventor, manufacturer, software developer, company, Web site creator, author of information).

Acceptable Use

2. Discuss basic issues related to responsible use of technology and describe personal consequences of inappropriate use (e.g., plagiarism, intellectual property, and the conditions of the district AUP).

3. Use technology to collaborate with others and credit all participants for their contribution to the work.

Benchmark E: Identify development patterns and examine the influence of technology on the world.

Grade Three

Technology and Assessment

1. Investigate and assess the influence of a specific technology on an individual.

2. Examine the trade-offs involved in selecting or using a product or system.

Grade Four

Technology and Assessment

1. Classify collected information in order to identify technology development patterns.

2. Investigate and assess the influence of a specific technology on families and the community.

3. Develop rules for evaluating the trade-offs when selecting or using a product or system.

Grade Five

Technology and Assessment

1. Compare, contrast and classify collected information in order to identify patterns of technology development.

2. Investigate and assess the influence of a specific technology on the environment.

3. Examine the trade-offs of using a product or system and decide when it should be used (e.g., determine the amount of supplies/luggage and mode of transportation needed for traveling various lengths of days and distances).

Grades 3-5

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: Understand computer and multimedia technology concepts and communicate using the correct terminology.

Grade Three

Basic Concepts
1. Discuss the purpose of various types of computer and multimedia technology equipment using appropriate terminology.

2. Communicate about computers and multimedia technology using correct terminology.

Grade Four

Basic Concepts
1. Learn and use new technology terminology based on the computer and multimedia technology resources being used.

2. Define technological terms as discovered.

Grade Five

Basic Concepts
1. Define and use new technology terminology based on the computer and multimedia technology resources being used.

Benchmark B: Use appropriate tools and technology resources to complete tasks and solve problems.

Grade Three

Basic Operations
1. Identify and use input and output devices to operate and interact with computers and multimedia technology resources (e.g., scanner, digital cameras).

2. Discuss networks and their use (e.g., how computers connect to printers, servers and the Internet).

3. Identify and use a variety of software programs.

4. Use technologies for particular content areas (e.g., calculators for math, computerized microscopes for science and books on CD-ROM for language arts).

Problem-solving

5. Show how you can find answers to problems by using electronic resources including the Internet.

Productivity Tools

6. Tell a story using presentation software.

Keyboarding

7. Touch-type letters on the keyboard with both hands (e.g., begin to learn how to type/keyboard, use continuous keystrokes).

Grade Four

Basic Concepts

1. Explain how input and output devices operate and interact with computers and multimedia technology resources.

Basic Operations

2. Demonstrate ability to login and use basic network services.

3. Discuss different software programs and what they do.

4. Discuss image formats (JPEG, GIF, TIFF).

5. Save, transport and access stored information from portable devices (e.g., portable hard drives, universal serial bus—USB devices, memory sticks).

Problem-solving

6. Demonstrate how technology productivity tools can be used to help understand data.

Productivity Tools

7. Collect/create digital images and sounds related to a particular topic.

Keyboarding

8. Demonstrate appropriate keyboarding skills.

Grade Five

Basic Concepts

1. Describe how networks are used to access, share and store information (e.g., software, printers, folders, files).

Basic Operations

2. Select the appropriate device to store needed information and independently save and access stored information from portable devices (e.g., how large is the saved information? do others need to use the information? what device will best store this information?).

Productivity Tools

3. Collect information for projects using still and video digital cameras, scanners and electronic resources.

4. Create a presentation using multimedia software that incorporates graphics, video and sound to present the findings of a group research project.

Research Tools

5. Investigate technology tools used for researching problems and acquiring information and data.

Keyboarding

6. Use appropriate hand/finger positions to key all letters (e.g., demonstrate ability to appropriately keyboard and assess accuracy).

Benchmark C: Use productivity tools to produce creative works and prepare publications.

Grade Three

Productivity Tools

1. Use and demonstrate how productivity tools support personal productivity (e.g., a word processing application can be used to create a letter, a spreadsheet application can be used to perform calculations, a database program can be used to compile and analyze data).

2. Use and demonstrate how peripherals support personal productivity (e.g., digital cameras are used to create images; scanners are used to create digital images; printers are output devices that allow us to make copies of what is created using technology; storage devices make it possible to store large amounts of information).

CommunicationTools

3. Identify/recognize technology resources for communication, collaboration, presentation and illustration of thoughts and ideas (e.g., e-mail, graphic organizers, video cameras, handheld devices).

Grade Four

Productivity Tools

1. Use productivity tools and peripherals to increase skills and facilitate learning throughout the curriculum.

Communication Tools

2. Use technology resources for collaborating and brainstorming ideas (e.g., use electronic formats of graphic organizers in groups).

3. Use media and technology resources for presenting information (e.g., projectors, video cameras).

Grade Five

Productivity Tools

1. Select and use appropriate software applications to complete content-specific tasks (e.g., use desktop publishing software to create a newsletter, use drawing programs to create artwork).

Communication Tools

2. Investigate technology resources for individual and collaborative writing, communication and publication of creative works (e.g., video editing, desktop publishing).

3. Use technology resources for presenting information (e.g., distance learning and interactive boards).

ACADEMIC CONTENT STANDARDS

Grades 3-5

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: Identify the concepts and operations of communication systems.

Grade Three

Design Elements	1. Include the elements of design such as contrast, size and arrangement of student-created projects in print and electronic media.
Use of Communications	2. Discuss the costs and connectivity of simple communication systems (e.g., e-mail, phones, Internet services).

Grade Four

Design Elements	1. Collect and evaluate examples of good design (contrast, size, arrangement) in print and electronic media.
Use of Communications	2. Investigate online learning environments (e.g., online courses, distance learning, videoconferencing and productions).
	3. Contribute to real-time classroom technology communication sessions.

Grade Five

Design Elements	1. Implement basic design components (contrast, size, arrangement) in print or electronic media productions.
Use of Communications	2. Determine ways in which people collaborate in real-time with individual and groups located in different school districts, communities, states and countries.
	3. Describe and participate in different types of online learning environments (e.g., online classes, distance learning, videoconferencing and productions).

Benchmark B: Develop, publish and present information in print and digital formats.

Grade Three

Design Elements
1. Use graphic organizers to sequence and organize information and projects.

Multimedia Applications
2. Incorporate the use of a digital image into a document (e.g., clipart, picture from digital camera or scanned images).

3. Use software to publish information in printed form (e.g., card, calendar, banner).

4. Use graphics and text within a slide show (e.g., create a presentation about Ohio's state bird, symbol or flag, as a presentation using pictures).

Use of Communications
5. Send and receive e-mail.

Grade Four

Multimedia Applications
1. Organize presentations by using storyboarding techniques.

2. Construct information by using a variety of software applications.

3. Edit digital images (e.g., crop, enhance brightness and/or contrast, adjust color, resize).

4. Generate a document that includes graphics from more than one source (e.g., find images that match assignment needs and insert them into a document).

5. Develop a slide show using graphics, text and audio from more than one source (e.g., create a presentation about Ohio government with text, pictures and music or narration).

6. Present information in a class video project.

Use of Communications
7. Identify the proper structure and components of e-mail:

    a.   Address structure;
    b.   Signature line;
    c.   Body of message;
    d.   Subject line.

8. Use e-mail to share information.

Grade Five

Multimedia Applications
1. Produce a slide show from storyboard, using text, graphics and sound with appropriate transitions and effects.

2. Collaborate in a class video project (e.g., act as camera operator, actor or director in a video project as part of a unit of study).

3. Use a simple authoring tool to create class Web page.

4. Evaluate and modify a presentation or document for different audiences (e.g., one person or a group of people).

5. Use advanced software features to publish information in printed form (e.g., card, calendar, banner, one-page report, flyer, newsletter).

Benchmark C: Use technology communications to participate in online group collaborative interactive projects and activities.

Grade Three

Use of Communications

1. Compose, send and reply to e-mail messages with teacher direction.

2. Engage in online learning (e.g., Web activities, virtual field trips, videoconferencing).

Grade Four

Use of Communications

1. Compose, send, receive and reply to e-mail.

2. Present and receive information in teacher/student directed online learning or videoconferencing activities (e.g., government agencies, historical society or museum).

Grade Five

Use of Communications

1. Demonstrate how to use e-mail to communicate with another student in a remote location.

2. Communicate in a monitored, online discussion (e.g., discuss books being read, share local history).

3. Gather and share information in online learning activities (e.g., examine historical journals and share observations).

Grades 3-5

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: Describe types of information: facts, opinions, primary/secondary sources; and formats of information: number, text, sound, visual, multimedia; and use information for a purpose.

Grade Three

Understanding Information

1. Distinguish between the concepts of information (organized data and facts) and data (raw facts and figures) and identify examples of each.

2. Recognize that information-gathering is based upon a need (e.g., gather information to learn more about a topic or gather information to answer questions).

Primary/Secondary Sources

3. Identify primary source information—firsthand information about a person, place or event and secondary source information—secondhand information interpreted by another person about a person, place, thing or event (e.g., primary sources such as diaries, letters, objects, and photographs; and secondary sources such as textbooks or biographies).

Grade Four

Understanding Information

1. Collect information (organized data and facts) and data (raw facts and figures) and identify answers to questions (e.g., locate data in a newspaper article, identify information on a sign).

2. Discuss and define the difference between fact and opinion (e.g., the cafeteria served pizza today—fact, the pizza was good—opinion).

3. Identify ways information can be presented (e.g., text, visual information on a map, information displayed in pictures or as graphics).

Primary/Secondary Sources

4. Use primary source material to describe a person, place, thing or event (e.g., oral history, diary entries, photos, etc.).

Grade Five

Understanding Information

1. Develop a systematic plan for organizing information using a basic organizing concept (e.g., subject, chronology, date).

2. Choose a variety of formats for presenting information (e.g., pictures, texts, slides).

3. Understand that there are conditions where information cannot be used (e.g., copyright restrictions on the use of cartoon characters, copying a classmate's project).

4. Distinguish between relevant and irrelevant information in an information source (e.g., information matches question to be answered, facts apply to the topic).

Primary/Secondary Sources

5. Apply primary and secondary sources to investigate a person, place, thing or event, and identify each source as primary or secondary.

Benchmark B: Use technology to find information by applying a research process to decide what information is needed, find sources, use information and check work.

Grade Three

Decide

1. Develop questions about an assigned topic and determine where the information may be found.

Find

2. Discuss search words: author, title, subject or topic.

3. Search for information in an online library catalog, electronic encyclopedia or teacher-selected list of Web sites.

Use

4. Select, record and use needed information to answer a question or complete a project.

5. Explain how to find copyright information on a resource (e.g., date of publication, copyright notice, statement of ownership).

6. Give credit to the sources used for work by listing the author, the name of the source and the copyright date.

Check

7. Explain how information was selected.

Grade Four

Decide

1. Determine questions to be answered by research.

2. Identify search terms for identified questions: author, title, subject, keyword.

Find

3. Select needed information from a defined group of resources: library catalog, online encyclopedia and subject list of age-appropriate Web sites.

Use	4. Record and organize information gathered from selected resources to generate a product.
	5. Construct a list of the sources used in creating the project: author, title of source and date.
Check	6. Evaluate the product to determine if the research questions were answered.

Grade Five

Decide	1. Identify questions related to an assigned topic or personal information need.
	2. Determine the best sources to use for the assigned topic or personal information need.
Find	3. Select and access information resources: online library catalog, Web sites and electronic formats (e.g., CD-ROM, DVD, audio files).
Use	4. Record and use selected information to create a product for the assigned topic or personal information need.
	5. Cite sources used: author, title of resource, publisher or source of information, and copyright date.
Check	6. Describe how information about a topic was gathered (e.g., discuss the information process).

Benchmark C: Use the Internet to find, use and evaluate information.

Grade Three

Internet Concepts	1. Label Internet browser elements and explain their function (e.g., toolbar and buttons, favorites/bookmarks, history).
Beginning Searching	2. Type a simple search term in a teacher- or librarian-selected search engine to find general information (e.g., "weather").
	3. Review the home page of a teacher- or librarian-selected Web site.
	4. Read the list of results retrieved from a simple search performed in a search engine, select one of the search results and review the information it provides.

Grade Four

Beginning Searching	1. Choose a search engine or directory specifically designed for students to locate information on the Internet.
	2. Type a simple search term in the search engine or directory to find facts and answer questions.

3. Read the list of results from the search engine or directory to locate potential Web sites relevant to the search topic.

Web Site Evaluation

4. Choose a Web site and examine the information for facts by identifying information on the Web site by:

    a.   Author;
    b.   Title;
    c.   Date produced;
    d.   Special features (images, puzzles, activities);
    e.   Available products, services or resources.

Grade Five

Internet Concepts

1. Explain the elements and meaning of a Web site URL: name of the site, domain, and extensions for specific pages.

Beginning Searching

2. Perform a search in an age-appropriate search engine or a Web directory by typing in one or more search terms.

3. Read list of results from the search and select potential relevant Web sites.

Web Site Evaluation

4. Identify information on the Web site: URL extensions, author, title, date produced, special features (images, puzzles, activities), products, services, resources, etc.

5. Examine the information retrieved from the Web site for the author's expertise, the accuracy of the information presented and the bias.

Benchmark D: Identify, access and use electronic resources from both free and fee-based Internet sources.

Grade Three

Electronic Resources

1. Use appropriate access code (username, password) to gain access to online resource (e.g., district network resources, subscription databases and resources that can be accessed remotely—outside the school and/or from home).

2. Use age-appropriate Internet resources and fee-based (subscription resources) delivered by the Internet.

Grade Four

Electronic Resources

1. Demonstrate use of online fee-based (subscription or pay-per-use) electronic resources (e.g., state- and/or district-provided resources such as magazine databases, encyclopedias, dictionaries).

2. Use a subscription resource or database (fee-based or pay-per-use) to locate information for a curricular need (e.g., select the subscription resource based on the curricular need).

Grade Five

Electronic Resources

1. Use a username and password to access an information source (e.g., an online library catalog, a fee-based Web site requiring user information to access the site, district network requiring student login).

2. Examine coverage of information in magazine databases, online biography sources and subject guide sources.

3. Distinguish different types of online information databases (free or fee-based) and select the best resource based on curricular need.

Grades 3-5

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: Describe and apply a design process to solve a problem.

Grade Three

Design Process	1. Describe the purpose of the design process (e.g., a purposeful method of planning practical solutions to problems).
	2. List the main elements of the design process—problem identification, possible solutions, refinement, analysis, decision, implementation and feedback.
Research and Development	3. Identify and collect information about everyday problems that can be solved by technology (e.g., pollution, energy shortage, housing).
Technical Communication	4. Make sketches to visualize possible solutions to a technological problem (e.g., sketch possible locations to more effectively place trash bins in the cafeteria using a computer drawing program or hand drawings).
Evaluating, Testing the Solution	5. List questions to use in evaluating solutions to a technical problem and distinguish between practical and poor solutions (e.g., does the solution really solve the problem? is it too expensive? is it too hard to do?).

Grade Four

Design Process	1. Apply the design process to purposefully solve a problem (e.g., how to improve recycling at school and home).
	2. Generate solutions for solving a problem using the design process with information collected about everyday technological problems.
Research and Development	3. Survey potential users to evaluate a solution to a technical problem

(e.g., survey other students about which type of model plane they like).

Technical Communication	4. Make sketches and paper models to visualize possible solutions to a technological problem (e.g., use computer drawing programs to prepare cut-out patterns).
Redesign	5. Recognize when changes to a solution are needed to meet the requirements.
Inventors/Inventions	6. Identify Ohio inventors and designers who contributed to the development of each of the technological systems:

        a.   Energy and power;
        b.   Transportation;
        c.   Manufacturing;
        d.   Construction;
        e.   Information and communication;
        f.   Medical;
        g.   Agricultural and related biotechnologies.

Grade Five

Design Process	1. Arrive at a solution to a technological problem and fabricate a prototype model for the solution.
	2. Use data to test and evaluate the prototype solution.
	3. Make sketches with a list of parts required for a solution to a technological problem.
Optimization and Trade-offs	4. Analyze the requirements for a design including such factors as the desired elements and features of a product or system and limits that are placed on the design (e.g., if the class were to prepare and deliver food to the homeless or a nursing home, what are the desired features and what limits are there to what can be done?).
Redesign	5. Improve the designed prototype solution when tests indicate need.
Inventors/Inventions	6. Identify American inventors and designers who contributed to the development of each technological system.

Benchmark B: Describe how engineers and designers define a problem, creatively solve it and evaluate the solution.

Grade Three

Innovation and Invention	1. Describe the importance of creativity in designing an object.
Strength and Materials	2. Identify natural forces that buildings must be designed to withstand (e.g., rain, earthquakes, tornados).

3. Recognize the importance of the materials to be used in a design (e.g., materials differ in strength, aesthetics, resistance to corrosion and wear).

Grade Four

Innovation and Invention
1. Describe how models are used to communicate and test design ideas and processes (e.g., model truss designs are tested for weight loads using bridge building simulation software).

Strength and Materials
2. Describe the structural needs to be met when designing an object (e.g., in designing a bridge, the maximum weight to be supported must be decided).

Technical Careers
3. Identify different types of engineers (e.g., manufacturing, architects, automotive, ceramic, materials, environmental, civil, electrical, agricultural, safety, biological, audio, mechanical, chemical).

Grade Five

Innovation and Invention
1. Demonstrate steps used in the engineering design process including defining the problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating the solution, and presenting the results (e.g., engineer a design to solve a storage problem at the school).

2. Evaluate a model used to communicate and test design ideas and processes (e.g., toy prototype, car models, building models).

3. Build models which can be used to communicate and test design ideas and processes (e.g., tornado shelters).

Benchmark C: Understand the role of troubleshooting in problem-solving.

Grade Three

Technical Problem-solving
1. Describe how troubleshooting is a way to find out why something does not work, so that it can be fixed.

Technical Careers
2. Identify people whose jobs regularly require them to troubleshoot (e.g., a cable repair person and a computer repair technician).

Grade Four

Technical Problem-solving
1. Apply the process of experimentation to solve a technological problem (e.g., test which glue works best for a given material).

2. Describe how scientific principles can be used in solving technological problems (e.g., will a stain look the same on different types of wood?).

Technical Careers

3. Identify different types of engineers and the types of problems they troubleshoot (e.g., manufacturing—incorrectly sized part, architects—weak structural support, automotive—exhaust pollution).

Grade Five

Technical Problem-solving

1. Show that invention and innovation are creative ways to turn ideas into real things (e.g., provide examples of multiple solutions to the same problem—many models of cars, varieties of apples, chess set figures).

2. Describe how the acceptance of a product can vary because of the size of the market (e.g., why is the commercialization of some products successful and others not?).

Grades 3-5

Standard 7: Designed World

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 and agricultural and related biotechnologies.

Benchmark A: Develop an understanding of how physical technologies enhance our lives.

Grade Three

Energy and Power	1. Describe how life would be different if we did not have energy delivered to our homes.
Transportation	2. Describe how transportation systems move people and goods from place to place.
Manufacturing	3. Diagram a processing system that converts natural materials into products (e.g., lumber harvested, transported to lumber mill, debarked, sawn to dimension, dried, transported to lumberyard, purchased, transported to site).
Construction	4. List systems that are used in buildings (e.g., electrical, heating and air conditioning, plumbing).

Grade Four

Energy and Power	1. Describe how energy is converted to produce light, heat and motion in machines and products.
	2. Describe how different devices consume different amounts of energy.

Transportation	3. Understand that transportation systems may lose efficiency or fail if one part is missing or malfunctioning, or if a subsystem is not working.
	4. Discuss how modes of transportation have changed over the years in Ohio.
Manufacturing	5. Explore, physically or virtually, manufacturing facilities and describe how products are designed, resources gathered, and tools used to separate, form and combine materials in order to produce products.
	6. Identify types of manufacturing done in Ohio (e.g., pottery, steel, glass, automobiles and chemicals).
Construction	7. Describe ways in which structures need to be maintained (e.g., floors waxed, walls painted, roofs replaced, drains cleaned).

Grade Five

Energy and Power	1. List tools, machines, products and systems that use energy in order to do work.
	2. Describe how personnel in energy and power technologies are trained (e.g., technician training, engineering school).
Transportation	3. Describe how the value of goods and services vary by their location.
	4. Describe how personnel in transportation technology are trained (e.g., apprenticeship, flight school, maritime school).
Manufacturing	5. Describe examples of how manufacturing enterprises exist because of a consumption of goods (e.g., clothing wears out, seasons change and styles change so more must be manufactured).
Construction	6. Describe the guidelines (zoning and building codes) that impact the construction of houses in your community.

Benchmark B: Recognize appropriate modes of technical communication across technological systems.

Grade Three

Information and Communication	1. Explain how the processing of information, through the use of technology, can be used to help humans make decisions and solve problems.
	2. Explore the importance of both the sender and receiver having the same understanding of the message.

Grade Four

Information and Communication	1. Describe how information can be acquired and sent through a variety of technological sources, including print and electronic media.

2. Use letters, characters, icons, symbols and signs to represent ideas, quantities, elements and operations.

Grade Five

Information and Communication

1. Use communication technology to transfer messages among people and/or machines locally and over distances through the use of technology.

2. Describe how personnel in information and communication technologies are trained.

Benchmark C: Develop an understanding of how bio-related technologies improve our lives.

Grade Three

Medical

1. Know that vaccines are designed to prevent diseases from developing and spreading; medicines are designed to relieve symptoms and stop diseases from developing.

Agriculture and Related Biotechnologies

2. Describe how artificial ecosystems are human-made environments that are designed to function as a unit and are comprised of humans, plants and animals.

Grade Four

Medical

1. Describe technological advances that have made it possible to create new devices, repair or replace certain parts of the body, and provide a means for mobility.

Agriculture and Related Biotechnologies

2. Identify agricultural waste and ways that it can be recycled or safely processed.

3. Describe how and explain why food is processed.

4. List foods grown or produced in Ohio.

5. Identify machinery used in the production of Ohio agricultural products.

Grade Five

Medical

1. Describe tools and devices that have been designed to help provide clues about health and provide a safe environment.

2. Describe how medical personnel are trained.

Agriculture and Related Biotechnologies

3. List processes used in agriculture that require different procedures, products or systems.

4. Describe how personnel in agricultural and related biotechnologies are trained.

Grades 6-8

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 Six

Technology Development

1. Recognize that there are multiple factors associated with developing products and systems.

2. Suggest alternative technological solutions for everyday problems that occur in the school or classroom.

3. Follow procedures for identifying and solving system and equipment problems that may occur.

4. Cite examples of how characteristics of technology are evident in daily life:

   a. Technology is based on human knowledge;
   b. Technology involves tools, materials and systems;
   c. Application of technology results in artifacts (things or items);
   d. Technology is developed by people to control natural and human-made environments.

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

Grade Six

Systems

1. Describe the relationship among input, process, output and feedback as components of a system.

Requirements

2. Define requirements as the parameters placed on the development of a product or system.

Controls

3. Recognize that controls are mechanisms or particular steps that people perform when using information about the system that causes systems to change.

Grade Seven

Systems

1. Differentiate between open-loop and closed-loop systems: recognize that an open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback.

2. Describe ways that technological systems can be connected to one another.

Requirements

3. Identify parameters that may be placed on the development of a product or system (e.g., cost, time, size).

Controls

4. Cite examples of controls, and predict resultant changes in a system for that control (e.g., the heating system thermostat regulates the air temperature of the room).

Trade-offs

5. Infer that malfunctions of any part of a system may affect the function and quality of the system.

Processes

6. Recognize that maintenance is the process of inspecting and servicing of a product or system on a regular basis.

Grade Eight

Systems	1. Demonstrate how technological systems can be connected to one another.
Requirements	2. Examine parameters and constraints in the design of a product or system.
Controls	3. Utilize controls to make changes in a system resulting in a desired outcome.
Trade-offs	4. Indicate ways a system malfunction may affect the function and quality of the system.
	5. Recognize that trade-offs are the result of the decision-making process, involving careful compromises among competing factors.

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

Grade Six

Technology Interaction	1. Identify technological systems that interrelate (e.g., computer peripherals, the engine and transmission of an automobile).
	2. Understand that products, systems and environments that have been developed for one setting may be applied to another setting.
	3. Recognize that knowledge from other fields of study impacts the development of technological systems and products.

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.

ACADEMIC CONTENT STANDARDS

Grades 6-8

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 Six

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

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

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

Grade Six

Technology and the Environment

1. Describe and give examples of why and how the management of waste produced by technological systems is an important societal issue.

2. Explain how technologies can be used to repair damage caused by natural disasters.

3. Identify an existing, or an area needing a riparian buffer, between a developed area and a natural stream or waterway.

Grade Seven

Technology and the Environment

1. Explain how the development and use of technologies often put environmental and economic concerns in direct competition with one another.

Trade-offs

2. Explain the life-cycle of a typical product or structure.

Product Life-Cycle

3. Describe the proper disposal and/or recycling of used products (e.g., electronic equipment, lawnmower oil, batteries).

Grade Eight

Technology and the Environment

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

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

Emerging Technology

3. Investigate emerging environmental restoration technologies (e.g., electrokinetic remediation to remove chemical contaminants from soil).

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

Grade Six

Technology and History

1. Describe how some inventions have evolved by using a deliberate and methodical process of tests and refinements.

2. Describe how in the past an invention or innovation was not always developed with the knowledge of science.

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.

Benchmark D: Articulate intellectual property issues related to technology and demonstrate appropriate, ethical and legal use of technology.

Grade Six

Intellectual Property

1. Understand the concept of intellectual property (e.g., author's ownership of work).

2. Compare key concepts of intellectual property including ownership of technology, copyright, patent, trademark, trade name, and discuss consequences of violating others intellectual property rights.

3. Distinguish original work from work that is plagiarized.

Acceptable Use

4. Follow policies presented in the district Acceptable Usage Policy (AUP) and discuss consequences of inappropriate use of technology.

Grade Seven

Intellectual Property

1. Analyze a situation to determine the steps necessary to respect intellectual property rights including patents, copyrights, trade names and trademarks.

2. Discuss plagiarism and its ramifications.

3. Understand that installation of software requires an appropriate software license, and that the license determines how many times the software may be installed (e.g., does the license allow the software to be installed on more than one computer?).

4. Understand that Web page content may not be copied and imported into a new owner's Web page.

5. Understand that photos, images, graphics, sounds or videos displayed on the Internet are generally copyright protected and may not be copied, pasted, saved, imported or used in new content without permission of the copyright owner.

6. Explore appropriate use of logos, icons, graphics, etc. in relation to trademark and trade name rights (e.g., understand that trademark logos may not be incorporated into new works without consent of the owner or payment of fees and/or royalties).

7. Analyze situations that arise regarding the use of intellectual property, including ethical considerations.

8. Determine steps necessary to respect intellectual property rights (e.g., obtain permission from the owner, credit the source of the items, pay a license fee to use the item).

Grade Eight

Intellectual Property

1. Demonstrate legal and ethical practices when completing projects/schoolwork.

2. Adhere to copyright restrictions.

3. Define fair use in regard to technology-generated educational materials.

4. Discuss software piracy, its impact on the technology industry, and possible repercussions to individuals and/or the school district.

5. Determine copyright, trademark, trade name restrictions to consider when using the Internet or other technology resources (e.g., do not violate intellectual property restrictions when using materials).

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

Grade Six

Technology Assessment

1. Employ the use of measuring instruments to collect data.

2. Use data collected to analyze and interpret trends in order to identify the positive or negative effects of a technology.

Grade Seven

Technology Assessment

1. Employ the use of instruments with different measuring standards to collect data (e.g., temperature, acidity—pH level, voltage, heart rate, speed).

2. Identify trends and monitor potential consequences of technological development.

3. Analyze an environmental health concern and identify the elements of that problem, (e.g., sources of environmental stressors, types of environmental stressors, environmental media, distribution of environmental stressors, and human receptors).

Grade Eight

Technology Assessment

1. Design and use appropriate instruments to gather data (e.g., design, fabricate and use a balance scale).

2. Interpret and evaluate the accuracy of the information obtained during a test or experiment and determine if it is useful.

Environmental Health

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).

Grades 6-8

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: Demonstrate an understanding of concepts underlying hardware, software and connectivity.

Grade Six

Understanding Concepts	1. Use vocabulary related to computer and multimedia technology systems (e.g., network, local area network—LAN, wide area network—WAN, wireless, connectivity).
Understanding Operations	2. Describe how computers connect to the Internet (e.g., what is the information super highway/World Wide Web and how can you connect to it?).

Grade Seven

Understanding Concepts	1. Use vocabulary related to computer and multimedia technology systems (e.g., universal serial bus—USB, hubs and switches).
Understanding Operations	2. Explain how computer components interact.
	3. Explain the purpose and different functions of software programs.

Grade Eight

Understanding Operations	1. Describe how computer and multimedia technology systems work (e.g., asynchronous transfer mode—ATM, Internet protocol—IP, local area networks—LAN, wide area networks—WAN, wireless).

Benchmark B: Select appropriate technology resources to solve problems and support learning.

Grade Six

Understanding Operations	1. Explain the purpose of software programs.
Communication Tools	2. Present independent research findings in a multimedia format.

Research Tools	3. Investigate technology tools used to organize and represent data collected in problem situations.
Keyboarding	4. Demonstrate proper keyboarding techniques, assess keyboarding accuracy and develop speed.

Grade Seven

Problem-solving	1. Solve problems using all available technologies for inquiry, investigation, analysis and presenting conclusions.
Productivity Tools	2. Investigate various formats of video content and methods of presentation (e.g., .mpeg, .avi).
	3. Edit video clips using video editing software.
Keyboarding	4. Develop speed and accuracy when keyboarding, and transition to a word processing environment.

Grade Eight

Problem-solving	1. Incorporate all available technology tools and resources to research, investigate, solve and present findings in a problem situation.
Productivity Tools	2. Create a video production related to a class activity.
Research Tools	3. Research educational video clips available online for use in class projects (e.g., consider copyright and fair use issues when selecting video clips).
Keyboarding	4. Demonstrate effective keyboarding skills in a word processing environment.

Benchmark C: Use productivity tools to produce creative works, to prepare publications and to construct technology-enhanced models.

Grade Six

Research Tools	1. Use content-specific tools, software and simulations to support learning and research (e.g., thermometers, applets, interactive geometric programs, model robots).
	2. Apply technology resources to create an educational project (e.g., use a spreadsheet to organize the data that represents the results from an experiment).

Grade Seven

Research Tools	1. Use content-specific tools, software and simulations to support learning and research to create educational projects (e.g., aerodynamic model design, bridge building simulation, design tools, how-it-works Websites).

2. Apply technology resources to support group collaboration and learning throughout the curriculum.

Grade Eight

Research Tools

1. Use content-specific tools, software and simulations to support learning, and research societal and educational problems (e.g., economic simulations, city planning simulation, flight simulators, rapid prototyping).

2. Apply technology resources to support personal productivity and learning throughout the curriculum.

ACADEMIC CONTENT STANDARDS

Grades 6-8

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: Communicate information technologically and incorporate principles of design into the creation of messages and communication products.

Grade Six

Communications	1. Explain that information is communicated for specific purposes.
Principles of Design	2. Define principles of design used to create print, multimedia and Web communications or products (e.g., color, contrast, repetition, alignment, proximity).
	3. Produce information products that incorporate principles of design.

Grade Seven

Communications	1. Classify reasons to communicate information and explain why technology enhances communication (e.g., to explain, inform, persuade, sell, archive information in ways that reach a variety of audiences).
Principles of Design	2. Integrate advanced design features into communication products (e.g., background selection, framing, set design).
Multimedia Applications	3. Generate multimedia presentations that communicate information for specific purposes.

Grade Eight

Communications	1. Determine audience characteristics that impact the content of the message (e.g., level of understanding, level of interest).
	2. Differentiate audience factors that influence the selection of the communication tool (e.g., will the message be communicated to an individual or a small or large group? will the message be communicated more than once?).

3. Examine the connections among message content, context and purpose (e.g., is the content of the message impacted by the context in which the message is given? does the context impact the purpose?).

4. Reconstruct messages with different communication tools and determine if the tool changes the meaning of the message.

Principles of Design

5. Identify and practice the following Universal Design principles that ensure accessibility for all users of communication projects or products:

   a.   Image size;
   b.   Alt attributes/tags;
   c.   Use of tables and frames;
   d.   Use of style sheets;
   e.   Formatting;
   f.   Use of color text legibility and readability;
   g.   Fonts, formatting and captioning.

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

Grade Six

Publication

1. Create and publish information in printed form (e.g., use software to produce homework assignments, reports, flyers, newsletters).

2. Develop and publish information in electronic form (e.g., slide presentations, multimedia products, Web materials).

Grade Seven

Productivity Tools

1. Select an appropriate software tool to create and publish print information (e.g., word processor for a report, desktop publishing tool for signs/calendars/newsletters).

2. Distinguish electronic file types and determine extensions including .txt, .rtf, .doc, .pdf and others.

3. Insert original sound files into multimedia presentation (e.g., AVI, WAV, MPEG).

4. Insert copyright-free images (photos/graphics) into multimedia presentations (e.g., GIF, JPEG).

5. Transform digital images by using editing software to:

   a.   Crop;
   b.   Rotate, flip, invert;
   c.   Add text, borders, decorative elements;
   d.   Adjust color (apply spot coloring, image touch-up);
   e.   Layer or merge images.

Grade Eight

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

2. Select appropriate file types (documents, sounds, images, and multimedia) based on communication need.

Evaluation
3. Evaluate information product based on content and audience (e.g., did the information communicate the intended message to the correct audience?).

Benchmark C: Select appropriate technology communication tools and design collaborative interactive projects and activities to communicate with others.

Grade Six

Use of Communications
1. Use e-mail functions including:

    a.   Sending;
    b.   Receiving;
    c.   Replying;
    d.   Adding a hyperlinked address in message;
    e.   Organizing mail folders;
    f.   Adding attachments to message.

2. Participate in discussion lists, message boards, chat and other means of appropriate electronic communication (e.g., ask-an-expert, pen pals).

3. Investigate assigned topics using online learning resources (e.g., weblogs, Web cast, videoconferencing and other distance learning opportunities).

Grade Seven

1. Compose e-mail messages and incorporate advanced techniques (e.g., include attachments, send to multiple recipients, format stationary, manage inbox, create address book).

2. Acquire and disseminate information by participating in virtual learning activities (e.g., Web casts, videoconferencing, distance learning offerings).

Grade Eight

Principles of Design
1. Design collaborative interactive activities or projects (e.g., online election for school office, survey, data collection).

Use of Communications

2. Disseminate results obtained through collaborative research projects to a larger audience (e.g., post results on a Web page, e-mail to group participants).

3. Select an appropriate communications tool to obtain and share information (e.g., e-mail, chat, message board, videoconferencing, online project).

Evaluation

4. Critique e-mail to determine communication clarity, and consider appropriate operations and etiquette (e.g., reply, reply all, include original message in reply, etc.).

ACADEMIC CONTENT STANDARDS

Grades 6-8

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: Evaluate the accuracy, authority, objectivity, currency, coverage and relevance of information and data sources.

Grade Six

Evaluating Sources

1. Select relevant information by identifying main ideas and supporting facts that help answer questions.

2. Determine that information located can be used legally and choose appropriately (e.g., locate copyright information for print and graphic information, check for copyright restrictions).

3. Check copyright and publication dates to determine currency of information.

4. Investigate the authority of an online information source to determine the author's qualification to be an expert about a topic (e.g., famous scientist versus a sixth-grader's Web site; well-known organization versus a personal Web site).

Grade Seven

Evaluating Sources

1. Distinguish when current copyright dates of sources are important in answering an information need (e.g., science information on cloning, results of an election).

2. Assess the objectivity (ability of an author to present information without bias) of a source when using information.

3. Compare multiple sources (online encyclopedia, Web site, online magazine database, print source) to check accuracy of information (e.g., do facts match on each site?).

4. Determine the scope of coverage for a given source (does the source cover all of the needed information?).

5. Chart information gathered from multiple sources to determine facts to be used in a project.

Grade Eight

Evaluating Sources

1. Understand the structure and organization of information sources including keywords, subject directory, subject search in a library catalog or search engine.

2. Demonstrate how to determine copyright issues when creating new products:

    a.   Ask permission to use articles, quotations and graphics;

    b.   Credit information to be included in the product.

3. Examine two Web sites with opposing viewpoints and describe the objectivity and intent of the author (e.g., candidates in an election, or other public issues).

4. Evaluate the validity of information by comparing information from different sources for accuracy (e.g., what makes the author an expert? is information the same in multiple sources?).

Benchmark B: Use technology to conduct research and follow a research process model which includes the following: developing essential question; identifying resources; selecting, using and analyzing information; synthesizing and generating a product; and evaluate both process and product.

Grade Six

Decide

1. Generate questions to be answered or a position to be supported when given a topic.

Find

2. Recognize that finding and using more than one source can produce a better product.

Use

3. Use a variety of technology resources for curriculum and personal information needs: library catalog, online encyclopedia, Web sites.

4. Examine information in different types of subscription resources—fee-based, pay-per-use to locate information for a curricular need (e.g., magazine database, picture archive, online encyclopedia).

5. Identify relevant facts, check facts for accuracy, record appropriate information and create an information product to share with others.

6. List information sources used in a district-adopted or teacher-prescribed format (e.g., MLA, APA).

Check   7. Review how the information found for the project was used and discuss the quality of the product.

Grade Seven

Decide   1. Develop open-ended research questions about a defined information need.

Find   2. Select and evaluate relevant information about a specific topic in several sources.

                   3. Select information from different types of subscription resources (fee-based, pay-per-use) to meet an information need (e.g., magazine database, picture archive, online encyclopedia).

Use   4. Compile information learned about a topic from a variety of sources.

                   5. Create information products to share information using different formats (e.g., print, audio recording, digital, video, slide show).

Check   6. Evaluate how information was found and assess the quality of the information product.

Grade Eight

Decide   1. Formulate an essential question to guide the research process.

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

Use   3. Analyze information, finding connections that lead to a final information product.

                   4. Demonstrate how to determine copyright issues when creating new products (e.g., permission to use articles and graphics, credit information to be included).

                   5. Use a teacher or district designated citation or style manual to credit sources used in work (e.g., MLA style manual, APA Guidelines or other selected style manuals).

                   6. Digitize information for archiving and future use (e.g., creating an electronic portfolio of curricular projects).

Check   7. Revise and edit information product.

                   8. Evaluate final product for its adherence to project requirements (e.g., recognize weaknesses in process and product and find ways to improve).

ACADEMIC CONTENT STANDARDS

Benchmark C: Develop search strategies, retrieve information in a variety of formats and evaluate the quality and appropriate use of Internet resources.

Grade Six

Internet Concepts

1. Explain the function of a Web browser (e.g., what is the difference between the browser software and a page on the Internet?).

2. Explain the difference between a subscription (fee-based database) and the free Internet.

Search Strategies

3. Identify keywords which describe the information need and use keywords as search terms (e.g., review search engine "help" page to determine methods for entering search terms).

4. Use phrase searching in appropriate search engines to improve results.

5. Incorporate place searching when searching for information using assigned directories and search engines.

Evaluating Sources

6. Evaluate Web information for:

   a.   Author's expertise (authority);
   b.   Accuracy of information presented;
   c.   Parameters of coverage (including objectivity and bias); and
   d.   Currency of information.

7. Compare the range of information available from multiple information databases (e.g., examine the purpose and scope of each database and how it would be used for a particular assignment).

Grade Seven

Internet Concepts

1. Recognize that some Web information requires special software for its use (e.g., discuss what plug-ins are and how they expand the use of the Internet).

Search Strategies

2. Search a student-selected online directory or search engine by subject, keyword, author, title, date and/or format.

3. Use Boolean operators in the search process (e.g., use Boolean logic to expand a search and to limit a search "AND" "OR" "NOT").

4. Perform searches for information in specific formats (e.g., graphics, images, journal articles).

5. Compare information found in searches done on different types of Internet resources (e.g., directory, search engine, meta engine).

Evaluating Sources

6. Report elements of a Web site that make it effective (e.g., describe why the Web site is appropriate for the particular information needed).

Grade Eight

Internet Concepts	1. Troubleshoot error messages in a Web browser (e.g., verify the address, use refresh and/or stop buttons).
Search Strategies	2. Incorporate Boolean operators in the search process for curricular needs (e.g., know the basic Boolean operators and use them in a search).

3. Compare information found in searches completed on different search engines (directories, spiders, meta crawlers) and discuss differences in how search engines select, rank and display information:

    a.   Relevancy;
    b.   Popularity; and
    c.   Paid placement.

Evaluating Sources   4. Compare several Web sites on the same topic and evaluate the purpose of each site (e.g., use several sites for a specific curricular need and note whether the sites have similar or conflicting data).

Benchmark D: Select, access and use appropriate electronic resources for a defined information need.

Grade Six

Electronic Resources	1. Demonstrate search techniques: author, title, subject for subscription (fee-based) databases.
	2. Use online library catalog to choose and locate a variety of resources on a topic.

Grade Seven

Electronic Resources	1. Compare search results through the use of different keywords (e.g., search for conservation information using "garbage" and search again using "waste disposal").
	2. Examine information in different types of subscription (fee-based) databases to locate information for a curricular need (e.g., online encyclopedia, online subject dictionaries, magazine index, picture archive).

Grade Eight

Electronic Resources	1. Select research databases that align with identified information need (e.g., specialized databases on government, science, history, as needed for assignments).
	2. Retrieve information in different types of subscription (fee-based) databases to support information for a curricular need.

3. Locate and use advanced search features and appropriate tools such as Boolean operators ("AND" "OR" "NOT") and a thesaurus in an online database.

ACADEMIC CONTENT STANDARDS

Grades 6-8

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: Evaluate the aesthetic and functional components of a design and identify creative influences.

Grade Six

Design Process	1. Describe how design is a creative planning process that leads to useful products and systems.
Requirements	2. Identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (e.g., weight, strength, hardness and flexibility) for the design.
Design Application	3. Apply a design process to solve a problem in the classroom specifying criteria and constraints for the design (e.g., criteria include function, size and materials; constraints include costs, time and user requirements).
Optimization and Trade-offs	4. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.
	5. Make the product or systems and document the design.
Redesign	6. Recognize that any design can be improved (e.g., old style scissors work but new ones with plastic on the finger holes are more comfortable and give more surface area for leverage).
Technical Communication	7. Diagram how design is iterative and involves a set of steps, which can be performed in different sequences and repeated as needed (e.g., identify need, research problem, develop solutions, select best solution, build prototype, test and evaluate, communicate, redesign).

Technical Careers	8. Investigate how products are created and communicate findings (e.g., interview an architect, industrial designer, contractor about the processes they follow).
Inventors/Inventions	9. Identify inventors and designers around the world who contributed to the development of each of the technological systems.

Grade Seven

Universal Design	1. Evaluate examples of Universal Design use that meet common challenges individuals encounter (e.g., limitations concerning mobility, vision, strength, reach and clarity in communication).
Technical Contradictions	2. Describe how aesthetic and functional components both complement and conflict with each other (e.g., a brace to keep a bookcase from rocking may not be consistent with the beauty of the object).
Research and Development	3. Review existing designs and suggest ways that they can be improved (e.g., how have food containers changed over time and how can they be improved?).
Technical Communication	4. Make two- and three-dimensional representations of the designed solution (e.g., 2-D includes sketches, drawings, and computer-aided designs—CAD and 3-D includes graphic, mathematical and physical models).
Technical Problem-solving	5. Describe how brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.
Design Application	6. Apply a design process to solve a problem in the school (e.g., identify need, research problem, develop solutions, select best solution, build prototype, test and evaluate, communicate, and redesign).
Technology Assessment	7. Research and diagram the product development life-cycle of an invention.
Inventors/Inventions	8. Identify inventors and designers from antiquity who contributed to the development of each of the technological systems (e.g., contributions from Chinese, Greeks, Romans, Arabs, Egyptians and Renaissance in Europe).

Grade Eight

Universal Design	1. Identify environments or products that are examples of the application of the principles of Universal Design (e.g., equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, size and space for approach and use).
Ergonomic Design	2. Apply ergonomic considerations to a design to maximize a design's ease of use and to minimize product liability (e.g., ergonomic keyboards decrease wrist injury).

Requirements	3. Categorize the requirements for a design as either criteria or constraints.
Optimization and Trade-offs	4. Document compromises involved in design (e.g., cost, material availability).
Design Application	5. Apply a design process to solve a problem in the community (e.g., identify need, research problem, develop solutions, select best solution, build prototype, test and evaluate, communicate, redesign).

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

Grade Six

Engineering Design	1. Describe how engineering design is a subset of the overall design process concerned with the functional aspect of the design.
	2. Examine how modeling, testing, evaluating and modifying are used to transform ideas into practical solutions (e.g., making adjustments to a model race vehicle to improve performance).
Technical Careers	3. Describe what an engineer does (e.g., analyze information found on engineering society Web sites).

Grade Seven

Engineering Design	1. Summarize the role of engineering design.
	2. Describe the relationship between engineering, science and mathematics.
	3. Describe and test the characteristics of various materials (e.g., strength, color, conductivity).

Grade Eight

Engineering Design	1. Explain how design involves a set of steps that can be performed in different sequences and repeated as needed (e.g., plan - do - study - act; problem analysis - design - coding and debugging - integration - testing and validation; define problem - identify options - identify best solution - plan how to achieve best solution - evaluate results).
	2. Identify how modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.
Strength and Materials	3. Test compression, tension and torsion strength of a material or system.

ACADEMIC CONTENT STANDARDS

Benchmark C: Understand and apply research, innovation and invention to problem-solving.

Grade Six

Technical Problem-solving	1. Examine how troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system (e.g., if after installing a switch in a circuit the light does not come on, how would you determine the problem?).
Design Application	2. Determine the best use of recycled plastics in the manufacture of new products (e.g., using seven different plastic packaging resin code-marked products).
Technology Assessment	3. Recognize the patterns of the technological evolution of an invention (e.g., steam engines were invented, went through a period of rapid improvement, followed by a period of fine tuning and eventually were replaced by diesel/electric technology).
Redesign	4. Modify an existing product or system to improve it (e.g., something to improve storage in your locker).

Grade Seven

Technical Contradictions	1. Explain that understanding the function of an object requires a higher level of thinking than focusing on the object itself.
Research and Development	2. Describe how some technological problems are best solved through experimentation.
	3. Describe and complete an experiment to evaluate the solution to a problem.
Technical Communication	4. Evaluate the credibility and applicability of information obtained to address a specific problem (e.g., what measurements should be used to build a chair or a piece of clothing?; are they based on the prospective customers?).
Technical Problem-solving	5. Distinguish between problems that do and do not have a technological solution (e.g., a recycling system and processes can be designed, but voluntary participation is a public attitude issue).
Technology Transfer	6. Identify the patterns of technological invention (e.g., identify the patterns of invention in current products and systems).

Grade Eight

Principles of Design	1. Explain the design axiom that form follows function.
Design Application	2. Invent a tool to solve a problem.

Optimization and Trade-offs   3. Describe how invention is a process of turning ideas and imagination into devices and systems; and innovation is the process of modifying an existing product or system to improve it.

Technology Assessment   4. Evaluate a variety of creativity-enhancing techniques.

Technology Transfer, Diffusion   5. Describe how inventions can have multiple applications, some not originally intended.

Innovation and Invention   6. Identify the five levels of innovation and describe their characteristics:

   a. Apparent or conventional solution;
   b. Small invention inside paradigm;
   c. Substantial invention inside technology;
   d. Invention outside technology; and
   e. Discovery.

Grades 6-8

Standard 7: Designed World

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 and agricultural and related biotechnologies.

Benchmark A: Develop an understanding of, and be able to, select and use physical technologies.

Grade Six

Energy and Power

1. Describe and use different energy storage devices.

2. Describe how power systems are used to drive and provide propulsion to other technological products and systems.

Transportation

3. Describe how transporting people and goods involve an interdependence of individuals and vehicles (e.g., flying from Orlando to Cleveland involves transportation to the departure airport, transportation through the airport, the flight, and transportation from the destination airport).

4. Identify and compare examples of transportation systems and devices that operate on each of the following: land, air, water and space.

Manufacturing

5. Produce a product using mechanical processes that change the form of materials through the processes of separating, forming, combining and conditioning them (e.g., build a solar cooker).

6. Classify manufactured goods at home as durable and nondurable (e.g., appliances, furniture, clothing, fabrics).

7. Explain and give examples of the impacts of interchangeable parts, components of mass-produced products, and the use of automation (e.g., robotics).

Construction

8. Describe why it is important that structures rest on a solid foundation.

9. Describe and explain parts of a structure (e.g., foundation, flooring, decking, wall, roofing systems).

Grade Seven

Energy and Power

1. Understand that energy can be used to do work using many processes.

2. Describe why it is important for personnel in energy and power technologies to constantly update their knowledge and skills.

3. Understand that power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done.

Transportation

4. Describe how transportation vehicles are made up of subsystems, such as structural, propulsion, suspension, guidance, control and support that must function together for a system to work effectively.

5. Describe how licensure and certification are an integral part of transportation careers (e.g., commercial driver's license, safety inspector's license, pilot's license).

6. Identify and manipulate the factors that influence vehicle performance (e.g., lift, drag, friction, thrust, pressure and gravity).

Manufacturing

7. Design, develop, fabricate and service a product (e.g., a pop bottle rocket, manufacture toys, clean computer keyboards).

8. Analyze how marketing impacts the selection of the manufacturing process for a product.

9. Safely disassemble a (possibly broken) product and describe what systems are inside, hypothesize how it was manufactured, and explain what materials were used and, possibly, how it works.

10. Describe a manufacturing organization (e.g., corporate structure, research and development, production, marketing, quality control, distribution).

Construction

11. Identify the components of various building subsystems (e.g., on pictures of classroom or various places in the school, label the electrical, lighting, HVAC, plumbing, communication and structural subsystems).

12. Identify and construct a type of structure (e.g., a model bridge including arch, beam and suspension) and their appropriate uses (e.g., site, span, resources and load).

Grade Eight

Energy and Power

1. Solve a problem involving energy and power systems (e.g., build a roller coaster for marbles, solar vehicles or solar cookers).

2. Explore ways that energy can be used more efficiently (e.g., improved insulation to reduce heat loss, improved aerodynamics to reduce drag, improved engines to increase efficiency).

3. Estimate and measure power consumption and compare estimates to actual measurements (e.g., compare real to the estimated energy bills at home).

Transportation

4. List the processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating and using conventions which are necessary for the entire transportation system to operate efficiently.

5. Describe how governmental regulations influence the design and operation of transportation systems (e.g., seatbelts, airbags, noise levels).

6. Describe why it is important for personnel in transportation technology to constantly update their knowledge and skills.

Manufacturing

7. Discuss how chemical technologies can be used in manufacturing processes (e.g., plastics, adhesives, insulation, personal care product).

8. Describe the location and extraction of natural resources that are used in manufacturing processes (e.g., harvesting, drilling and mining).

9. Explain and utilize basic processes in manufacturing systems (e.g., cutting, shaping, assembling, joining (including stitching), finishing, quality control and safety).

10. Organize and implement an enterprise to manufacture a product.

Construction

11. Describe how the selection of designs for structures is based on factors such as building laws and codes, including Americans with Disabilities Act concerns, style, convenience, cost, climate and function.

12. Explain how the forces of tension, compression, torsion, bending and shear affect the performance of structures.

13. Describe and model the effects of loads and structural shapes on structures.

ACADEMIC CONTENT STANDARDS

Benchmark B: Develop an understanding of, and be able to, select and use informational technologies.

Grade Six

Information and Communication
1. Describe how information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.

2. Demonstrate the importance of a common language to express ideas through the use of symbols, measurements and drawings.

Grade Seven

Information and Communication
1. Identify the source, encoder, transmitter, receiver, decoder and destination in communication systems.

2. Solve a problem involving information and communication technological systems (e.g., prepare a video presentation, set up a communication system between two points in the school).

3. Identify and explain the appropriate tools, machines and electronic devices (e.g., drawing tools, computer-aided design, and cameras) used to produce and/or reproduce design solutions (e.g., engineering drawings, prototypes, and reports).

Grade Eight

Information and Communication
1. Explain the factors that influence message design (e.g., intended audience, medium, purpose, budget and nature of message).

2. Describe why it is important for personnel in information and communication technologies to constantly update their knowledge skills.

Benchmark C: Develop an understanding of how bio-related technologies have changed over time.

Grade Six

Medical
1. List advances and innovations in medical technologies that are used to improve health care (e.g., prevention, diagnosis, treatment, rehabilitation).

2. Describe why it is important for medical personnel to constantly update their knowledge and skills.

3. Explain that there are a variety of diagnostic methods and treatments for a medical problem.

4. Describe how advances in a variety of technological systems influence the development of medical devices.

Agriculture and Related Biotechnolgies

5. Describe how technological advances in agriculture directly affect the time and number of people required to produce food for a large population.

6. Describe how biotechnology applies the principles of biology to develop commercial products or processes.

Grade Seven

Medical

1. Describe how the sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease and shape the ethics of medical safety.

2. Describe how previously discarded medical practices are sometimes reinstated.

3. Recognize how the medicines we use affect our ongoing health and attitudes.

4. Explain examples of adaptive or assistive devices (e.g., prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces, computer devices).

Agriculture and Related Biotechnologies

5. Describe a wide range of specialized equipment and practices that are used to improve the production of food, fiber, fuel and the care of animals.

6. Identify artificial ecosystems that are human-made complexes that replicate some aspects of the natural environment.

7. Describe how agricultural products are used to produce fuels (e.g., converting corn to ethanol and soy beans to biodiesel).

Grade Eight

Medical

1. Relate how vaccines developed for use in immunization require specialized technologies to support/control environments in which a sufficient amount of vaccines are produced.

2. Describe how licensure is an integral part of medical careers.

3. Recognize the need for appropriate models in testing medicines and medical procedures (e.g., medicine testing that developed dosages for adult males but was used for children and females).

4. Describe how technology is used to protect people from disease and illness, but can also aid their spread.

Agriculture and Related Biotechnologies

5. Explain that the development of refrigeration, freezing, dehydration, preservation and irradiation allows for long-term storage of food and reduces the health risks caused by tainted food.

6. Describe why it is important for personnel in agriculture and biotechnologies to constantly update their knowledge and skills.

ACADEMIC CONTENT STANDARDS

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 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.

Grade Ten

Optimization and Trade-offs	1. Describe situations in which the selection of resources involves trade-offs between competing values, such as availability, desirability, cost and waste (e.g., use of plastic in manufacturing has many advantages, but may put the environment at risk and deplete natural resources).

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.

Grade Twelve

Nature of Technology	1. Design/construct a model to demonstrate how all components contribute to the stability of a technological system.

Optimization and Trade-offs   2. Make, support and defend decisions that involve trade-offs between competing values (e.g., use of criteria in making an equipment purchase).

Sustainability   3. Evaluate the sustainability of a system based on social, economic, political, technological, cultural, historical, moral, aesthetic, biological and physical dimensions.

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.

Grades 9-12

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: 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).

Grade Ten

Technology and Citizenship
1. Understand that the development of technology may be influenced by societal opinions and demands, in addition to corporate cultures.

2. Contrast ethical considerations and how they are important in the development, selection and use of technologies.

Technology Transfer
3. Provide examples of how transfer of a technology from one society to another can cause cultural, social, economic and political changes

affecting both societies to varying degrees (e.g., World War II industrial mobilization drew women into the work force).

4. Identify capabilities and limitations of contemporary and emerging technology resources and assess the potential of these systems and services to address personal, lifelong learning and workplace needs.

5. Analyze advantages and disadvantages of widespread use and reliance on technology in the workplace and in society as a whole.

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 workplace 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.

Grade Twelve

Technology and Citizenship

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

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

3. Debate the advantages and disadvantages of widespread use and reliance on technology in the workplace and in society as a whole.

4. Evaluate national and international policies that have been proposed as ways of dealing with social changes resulting from new technologies (e.g., censorship of the media, intellectual property rights or organ donations).

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.

Grade Ten

Technology and Environment
1. Explain how, with the aid of technology, various aspects of the environment can be monitored to provide information for decision-making (e.g., satellites can be used to monitor wetlands in order to control disease spread by mosquitoes).
2. Understand that the appropriate design of technological devices and systems maximizes performance and reduces negative impacts on the environment (e.g., design vehicle components for ease of recycling after use).

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.

Grade Twelve

Technology and Environment
1. Forecast intended and unintended consequences of technology deployment.
2. Describe the proper disposal and recycling of computer components and other electronic devices.

ACADEMIC CONTENT STANDARDS

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.

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.

Grade Ten

Technology and Ethics

1. Describe/discuss the ethical considerations involved in the development or deployment of a technology.

2. Analyze technology law, legislation and policy in context of user rights and responsibilities.

3. Understand the importance of diverse information and access to information in a democratic society.

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.

Grade Twelve

Technology and Ethics

1. Predict what might happen if the principles of intellectual property were ignored in one's own community.

2. Forecast changes in laws and legislation that might result from the exponential growth of technology.

3. Respect the principles of intellectual freedom and intellectual property rights.

4. Practice responsible and ethical usage of technology.

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.

Grade Ten

Technology Assessment

1. Synthesize data, analyze trends and draw conclusions regarding the effect of technology on the individual, society and environment (e.g., current and historical time periods).

2. Produce graphs and/or charts to describe trends and visualize data.

3. Describe how a technological change has affected the local community (e.g., how a new highway has changed traffic and building patterns).

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.

Grade Twelve

Technology Assessment

1. Design forecasting techniques to evaluate the results of altering natural systems.

2. Select a technology that has had national impact and describe its impact.

Grades 9-12

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 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.

Grade Ten

Understanding Operations
1. Examine current and past devices for storing data and predict potential devices for the future.

2. Analyze various types of connectivity and list pros and cons of each.

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

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.

Grade Twelve

Problem-solving
1. Research and create 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 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).

Grade Ten

Productivity Tools
1. Utilize advanced word processing and desktop publishing features and programs.

Communication Tools
2. Use equipment related to computer and multimedia technology imaging (e.g., digitalization, optical character recognition, scanning, computerized microscopes).

Problem-solving
3. Identify/recognize state-of-the-art technology tools for solving problems and managing personal/professional information.

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).

Grade Twelve

Knowledge Generation
1. Assimilate productivity and technological tools into all aspects of solving problems and managing personal information and communications.

2. Use technology tools to model complex systems of information to improve the communication of and access to the information (e.g., modeling physics principles, graphic/geographic information system, weather modeling).

Grades 9-12

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 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.

Grade Ten

Publication

1. Publish information in printed and electronic version, and select appropriate publication format (e.g., paper, Web, video).

Evaluation

2. Evaluate communication products.

ACADEMIC CONTENT STANDARDS

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.

Grade Twelve

Use of Communications

1. Use Web technologies to disseminate information to a broader audience.

Evaluation

2. Explain evaluation criteria and processes used to communicate with technology (e.g., telecommunications, Wi-Fi, voice over IP).

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).

ACADEMIC CONTENT STANDARDS

Grades 9-12

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 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.

Grade Ten

Evaluating Sources
1. Examine information for its accuracy and relevance to an information need (e.g., for a report on pollution, find information from sources that have correct and current information related to the topic).

2. Identify relevant facts, check facts for accuracy and record appropriate information (e.g., follow a standard procedure to check information sources used in a paper).

3. Create a bibliography of sources in an electronic format.

4. Select appropriate information on two sides of an issue (e.g., identify the author of each information source and their expertise and/or bias).

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.

Grade Twelve

Evaluating Sources

1. Evaluate information collected to answer both personal and curricular needs to determine its accuracy, authority, objectivity, currency and coverage.

2. Acknowledge intellectual property in using information sources.

3. Determine and apply an evaluative process to all information sources chosen for a project.

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).

Grade Ten

Decide   1. Select the essential question to be examined by the research.

                2. Identify sources most likely to have the needed information and determine subjects and keywords to be used in searching magazine databases and other electronic reference resources.

Find   3. Evaluate information and select relevant and pertinent information found in each source, and maintain accurate records of sources used.

Use	4. Organize and analyze information, finding connections that lead to a final product.
	5. Follow copyright law and use standard bibliographic format to list sources.
Check	6. Assess whether the essential questions are answered, gather more information and data and modify search terms as needed. Edit the product.
	7. Review and evaluate research process and the resources used (e.g., how can the research process be improved?).

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.

Grade Twelve

Decide	1. Derive a personally developed research model to conduct independent research.
	2. Refine the information question to focus the research process, modifying the question as necessary to broaden or narrow the inquiry.
Find	3. Critique information sources to determine if different points of view are included.
	4. Integrate multiple information sources in the research process.
Use	5. Create a product to communicate information, representing a personal point of view based on findings.
	6. Adhere to copyright and intellectual property laws and guidelines when creating new products (e.g., standard bibliographic format, permissions to use information created by others).
Check	7. Monitor progress and evaluate actions during the process, revising and incorporating new information as indicated by personal evaluation.

Manage

8. Archive the final product in a format that will be accessible in the future.

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.

Grade Ten

Search Strategies

1. Construct an effective search strategy to retrieve relevant information through multiple search engines, directories and Internet resources.

2. Narrow or broaden the search strategy by modifying the keywords entered in the original search strategy.

3. Employ a systematic approach to judge the validity of a Web information match against the defined information need (e.g., researching an author through the Web requires finding biographical information plus criticisms of the author's works).

Evaluating Sources

4. Examine the information retrieved through Internet searching for authenticity of information, bias, currency, relevance and appropriateness.

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.

Grade Twelve

Search Strategies

1. Incorporate defined field searching by initiating a search string identifying the desired field of information to be retrieved (e.g., search author or title).

2. Create a stand-alone system for tracking Internet resources for personal and academic needs (e.g., postsecondary institutions of interest).

Evaluating Sources

3. Synthesize search results retrieved from a variety of Internet resources to create an information product for a targeted audience.

4. Critique research retrieved through the Internet for authority, accuracy, objectivity, currency, coverage and relevancy.

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

Grade Nine

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).

Grade Ten

Electronic Resources

1. Choose a topic and identify appropriate electronic resources to use, citing the name and date of the resource database archive collection.

2. Research and critique information in different types of subscription (fee-based) electronic resources to locate information for a curricular need.

3. Investigate tools within electronic resources to generate search strategies (e.g., use a thesaurus to identify subject terms for improved retrieval of information).

ACADEMIC CONTENT STANDARDS

Grade Eleven

Electronic Resources

1. Modify a search through the use of different keywords 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.

Grade Twelve

Electronic Resources

1. Research information from electronic archives (e.g., list serv archives, weblogs).

2. Use a variety of technology resources for curriculum and personal information needs (e.g., streaming video, CD/DVD, subscription database).

3. Evaluate technology resources and determine strengths and weaknesses for curricular or personal needs.

4. Select an appropriate tool, online resource or Website based on the information need.

ACADEMIC CONTENT STANDARDS

Grades 9-12

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).

Standard 6: Design

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 interrelationship 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.

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

Grade Ten

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.

ACADEMIC CONTENT STANDARDS

Grades 9-12

Standard 7: Designed World

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 and 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).

Grade Ten

System Management

1. Differentiate between open (e.g., irrigation, forced hot air system) and closed (e.g., forced hot water system, hydroponics) fluid systems and their components such as valves, controlling devices and metering devices.

2. Understand that all energy delivery systems need an infrastructure (e.g., identify features of natural gas and gasoline pipeline distribution systems across Ohio).

Safety

3. Safely use the tools and processes of energy and power technological systems.

Engineering Practice

4. Explain the relationship between resistance, voltage and current (Ohm's Law).

Use and Maintain Technological Systems

5. Build energy and power devices using the appropriate technological tools, machines, equipment, materials and technical processes to solve a problem in the community.

6. Identify the sources of energy, conversion process, and load in a variety of power systems (e.g., tractor, electrical grid, elevator).

7. Differentiate among conduction, convection, and radiation in a thermal system (e.g., heating and cooling a house, cooking).

8. Identify and explain the components of a circuit including a source, conductor, load and controllers (controllers are switches, relays, diodes, transistors, integrated circuits).

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., 45° elbow, 90° elbow, type of pipes, changes in diameter) for water moving through a pipe.

3. Use a 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 CO_2 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).

Grade Twelve

Engineering Practice

1. Explain Bernoulli's Principle and its effect on practical applications (e.g., airfoil design, spoiler design, carburetor).

Design Application

2. Explain why no system is 100 percent energy efficient.

3. Determine the energy efficiency of a transportation system (e.g., compare the energy used to transport a person from Dayton to Cleveland by automobile, bus and airplane).

4. Explain how environmental conditions influence heating and cooling of buildings and automobiles.

Technical Standards

5. Identify and apply appropriate codes, laws, standards or regulations related to energy and power technologies (e.g., American Society of Heating, Refrigeration, Air-Conditioning Engineers—ASHRAE, Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency—Ohio EPA, American National Standards Institute—ANSI).

ACADEMIC CONTENT STANDARDS

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).

Grade Ten

System Management

1. Describe how transportation services and methods have led to a population that is regularly on the move.

Design Applications

2. Describe the factors that influence the cost of producing technological products and systems in 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.

Grade Twelve

Design Application

1. Design transportation systems using innovative techniques (e.g., a system to more efficiently transport people in the Cincinnati, Columbus, Cleveland corridor).

Technical Standards

2. Identify and apply appropriate codes, laws, standards or regulations related to transportation technologies (e.g., National Highway Safety Board—NHSB, Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency—Ohio EPA, American National Standards Institute—ANSI).

ACADEMIC CONTENT STANDARDS

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 (e.g., customized production, batch production and continuous production) appropriate to the context.
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.

Grade Ten

Use and Maintain Technological Systems	1. Explain the manufacturing processes of casting and molding, forming, separating, conditioning, assembling and finishing.
	2. Demonstrate the ability to acquire, store, allocate, and use materials or space efficiently.
	3. Identify and investigate modern production technology practices and equipment in manufacturing technologies (e.g., just-in-time, lean production, six-sigma, new automation processes, systems, materials, tools).
Design Applications	4. Demonstrate how the interchangeability of parts increases the effectiveness of manufacturing processes (e.g., manufacture a product using interchangeable parts; repair a product using replacement parts).
	5. Use marketing to establish a product's viability and identity, conduct research on its potential, advertise it, package it, distribute it and sell it.

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).

Grade Twelve

Use and Maintain Technological Systems

1. Describe how chemical technologies provide a means for humans to alter or modify materials and produce chemical products (e.g., adhesives, plastics, ethanol production, coatings).

2. Explain the process and programming of robotic action utilizing three axes.

Technical Standards

3. Identify and apply appropriate codes, laws, standards or regulations related to manufacturing technologies (e.g., Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency—Ohio EPA, American National Standards Institute —ANSI).

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).

Grade Ten

Engineering Practice	1. Identify and explain the engineering properties of materials used in structures (e.g., elasticity, plasticity, thermal conductivity, density).
	2. Identify and investigate modern production technology practices and equipment in construction technologies (e.g., new building techniques, materials, tools).
Use and Maintain Technological Systems	3. Construct a structure using a variety of processes and procedures (e.g., material use, how it is assembled, and skill level of worker).
	4. Describe how structures can include prefabricated materials (e.g., residences, bridges, commercial buildings).
	5. Identify and explain the purposes of common tools and measurement devices used in construction (e.g., spirit level, laser transit, framing square, plumb bob, spring scale, tape measure, strain gauge, venturi meter, Pitot tube).
	6. Demonstrate the ability to acquire, store, allocate, and use materials or space efficiently.

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 a new roof is 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).

Grade Twelve

Engineering Practice

1. Calculate quantitatively the resultant forces for live loads and dead loads.

Use and Maintain Technological Systems

2. Create a product (or prototype) or system in construction technologies using the appropriate technological tools, machines, equipment and technical processes.

Design Applications

3. Describe how the design of structures requires the interaction of style, convenience, efficiency and safety (e.g., visit local buildings designed for the same purpose and describe how the style, convenience, efficiency and safety vary).

Technical Standards

4. Identify and apply appropriate codes, laws, standards or regulations related to construction technologies (e.g., local building codes, Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency—Ohio EPA, American National Standards Institute—ANSI).

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.

Grade Ten

Technical Communication

1. Use multiple ways to communicate information, such as graphic and electronic means (e.g., graphic—printing and photochemical processes; electronic—computers, DVD players, digital audiotapes, MP3 players, cell and satellite phones; multimedia—audio, video, data).

2. Communicate technological knowledge and processes using symbols, measurement, conventions, icons, graphic images and languages that incorporate a variety of visual, auditory and tactile stimuli.

3. Identify and explain the applications of light in communications (e.g., reflection, refractions, additive and subtractive color theory).

4. Compare the difference between digital and analog communication devices.

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).

Grade Twelve

Use and Maintain Technological Systems

1. Use information and communications systems to inform, persuade, entertain, control, manage and educate (e.g., Internet, telephones, cell

and satellite phones, smart phones, TVs, radios, computers, fax machines, PDAs, mobile communicators).

Design Applications 2. Address a communication problem involving the community (e.g., presenting information to the school board or town council).

3. Analyze a dysfunctional communication system and suggest improvements (e.g., the school public address system).

4. Identify and explain the applications of laser and fiber optic technologies (e.g., telephone systems, cable TV, medical technology, and photography).

Technical Standards 5. Identify and apply appropriate codes, laws, standards or regulations related to information and communication technologies (e.g., International Electrical and Electronic Engineers—IEEE, Federal Communication Commission—FCC, Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency —Ohio EPA, American National Standards Institute—ANSI).

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.

Grade Ten

Understanding Technological Systems 1. Describe how technology has impacted medicine in the areas of prevention, diagnostic, therapeutic treatment and forensics (e.g., medical tools, instruments, materials, monitoring equipment).

2. Describe how medicines and treatments have both positive and negative effects.

Safety	3. Safely use the tools and processes of medical technological systems (e.g., virtual dissection software).

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.

Grade Twelve

Technical Communication	1. Describe how telemedicine reflects the convergence of technological advances in a number of fields, including medicine, telecommunications, virtual presence, computer engineering, informatics, artificial intelligence, robotics, materials science and perceptual psychology.
	2. Classify the ways medical technologies are regulated.
Technical Standards	3. Identify and apply appropriate codes, laws, standards or regulations related to medical technologies (e.g., Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency —Ohio EPA, American National Standards Institute—ANSI).

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

Grade Ten

Understanding Technological Systems	1. Explain the conservation practices of controlling soil erosion, reducing sediment (contamination) in waterways, conserving water, and improving water quality (e.g., terraces as used in gardens and farmland).
	2. Grow a plant using both hydroponics and traditional methods and compare the results.
Safety	3. Prioritize and apply appropriate safety measures when working with 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 distribution center grown hydroponically and traditionally).

Grade Twelve

Design Applications	1. Describe how engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna (e.g., green houses, fish farms, hydroponics, aquaculture).
Technology Assessment	2. Evaluate the effects of genetic engineering, fertilizers, herbicides, and pesticides on the environment and the production of food.
Technical Standards	3. Identify and apply appropriate codes, laws, standards or regulations related to agricultural and biotechnologies (e.g., Occupational Safety and Health Administration—OSHA, National Electric Code—NEC, International Standards Organization—ISO, Ohio Environmental Protection Agency—Ohio EPA, American National Standards Institute—ANSI, Ohio Department of Agriculture).