

## K-12 Technology

# Foreword

We are excited to announce that the State Board of Education took another key step in reforming Ohio's education system December 9, 2003, when it unanimously adopted academic content standards in technology, fine arts and foreign language. Clear standards delineate what students should know and be able to do in technology, fine arts and foreign language. These standards will be an integral component of an aligned system that will ensure no child is left behind.

This enormous undertaking could not have occurred without the hard work and dedication of Ohio's educators and community members. The work on the technology, fine arts and foreign language standards began with the seating of advisory committees, which made preliminary decisions that guided the work of the writing teams. Classroom teachers, parents, higher education faculty and business and community leaders from across the state worked for several years as writing teams to develop the academic content standards. We especially want to extend our gratitude to all the men and women on the standards development teams who gave their time, energy and expertise to create these standards.

The people of Ohio played a key role in the development of the academic content standards. The Office of Curriculum and Instruction at the Ohio Department of Education facilitated the standards writing process and aggressively engaged the public in reviewing drafts of the standards throughout the development process. Thousands of Ohioans provided suggestions that were evaluated and incorporated, as appropriate, by the writing teams into the final adopted standards. We want to thank all of the people who took the time to comment on the standards and participate in the development process.

Ohio's standards in technology, fine arts and foreign language were reviewed by national experts who examined the content, developmental appropriateness and curricular considerations of the standards. Overall, the reviewers found Ohio's standards to be clear and comprehensive, setting high expectations for student learning.

The standards adoption fulfills one of the requirements of Amended Substitute Senate Bill 1, which calls for the State Board of Education to develop and adopt clear academic content standards. The bill also calls for the Department of Education to design and produce model curricula aligned to the standards for Kindergarten through 12th-grade. Curriculum models are resources that provide specific tools which teachers may use in their classroom planning and instruction as they implement a standards-based education.



# ACADEMIC CONTENT STANDARDS

The aligned system of standards, curricula and assessments will form the foundation for an accountability system that assists schools, school districts and the state in focusing resources on improving student achievement.



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## K-12 Technology

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K-12 Technology

# Overview



# ACADEMIC CONTENT STANDARDS

## K-12 Technology

The Ohio technology academic content standards provide a set of clear, rigorous expectations for what all students should know and be able to do. The technology standards address a broad range of technology experiences with application in *computer and multimedia literacy*, *information literacy* and *technological literacy* in order to provide the best possible foundation for technology achievement. Taken together, the technology standards will assist districts in planning fully articulated programs of technology study and in designing curriculum that will enable students to achieve the No Child Left Behind Eighth Grade Technology Literacy requirement.

- **Computer and Multimedia Literacy** includes the ability to appropriately use hardware, software applications, multimedia tools and other electronic technology. It harnesses the use of educational technology tools for productivity, communication, research and problem-solving.
- **Information Literacy** is the acquisition, interpretation and dissemination of information. Information literacy focuses on effective methods for locating, evaluating, using and generating information. Technology-based information literacy skills encompass the utilization of the Internet and other electronic information resources for research and knowledge building.
- **Technological Literacy** addresses the abilities needed to participate in a technological world. It is the intersection of mathematics, science and technology. It specifies unique knowledge, devices, and capabilities used to solve problems. It identifies career connections between technology and the world of work. Technological literacy includes technology education and pre-engineering concepts.

The following seven standards represent technology content that **all** students should know and be able to do as they progress through a kindergarten through grade 12 program. While the standards appear in linear fashion, they represent a connected body of understandings and competencies rather than a list of discrete topics from which to choose. Concepts from the technology standards should be embedded with content from other disciplines. Combining technology instruction with the study of other disciplines, such as mathematics, science or social studies helps reinforce the learning within each discipline. Integration of content from other disciplines supports state-assessed areas of the curriculum.

Content Standards: Nature of Technology  
Technology for Society Interaction  
Technology for Productivity Applications  
Technology and Communication Applications  
Technology and Information Literacy  
Design  
Designed World



## The Development of Academic Content Standards

Joint Council of the  
State Board of Education and  
the Ohio Board of Regents  
Academic Content Standards

The process of developing Ohio's academic content standards began in 1997 when the State Board of Education and the Ohio Board of Regents created a Joint Council to oversee the implementation of recommendations made by the Secondary and Higher Education Remediation Advisory Commission. The boards began to build a common, long-term agenda for pre-kindergarten through 16 education.

The Joint Council started its work by establishing a set of common expectations describing what all students should know and be able to do upon completion of high school. The initial work established "common expectations" in six content areas: (1)the fine arts; (2)English language arts; (3)foreign languages; (4)mathematics; (5)science; and (6)social studies. The seventh area "technology" was added through the passage of Amended Substitute Senate Bill 1.

The Joint Council assembled advisory groups to assist in planning for the process of drafting Ohio's new academic content standards. This planning included review of exemplary standards from the United States and other countries, and the formulation of strategic policy recommendations. The recommendations ensured that the drafting and refining of academic content standards would respect Ohio's history of sharing responsibility for curriculum decisions with Ohio's diverse learning communities.

Writing teams consisted of representatives from all 12 regions served by the ODE's Regional Professional Development Centers and included kindergarten through grade 12 educators as well as career-technical educators, educators of exceptional children and higher education faculty. Ohio's diverse ethnicity, geography, types of school districts, and colleges and universities were represented on the writing teams. The writing teams also included parent and business/community representatives.

As the writing teams completed major drafts of the academic content standards, the documents were subjected to periods of public engagement and rigorous review. Focus group meetings and electronic feedback via the ODE Web page allowed stakeholders to express their opinions. The writing teams reviewed the public feedback and made revisions in response to the issues raised. The draft academic content standards presented to the State Board of Education for adoption reflect the final recommendations of this writing process and include grade-level indicators of progress (kindergarten through grade 12), benchmarks that serve as checkpoints at key grade bands, philosophies and guiding assumptions.



# ACADEMIC CONTENT STANDARDS

## Development and Implementation Timeline

Based on Amended Substitute Senate Bill 1

	English Language Arts	Mathematics	Science	Social Studies	Fine Arts Foreign Language Technology
<b>Development</b> ↑ ↓	(1) Assemble Advisory Committee	↓	↓	↓	↓
	(2) Identify Writing Team				
	(3) Develop Draft Standards and Benchmarks				
	(4) Convene Writing Team				
	(5) Seek Focused Input				
	(6) Engage the Public				
	(7) Revise Draft Standards and Benchmarks				
(8) Adoption of Academic Content Standards by the State Board of Education	December 2001	December 2001	December 2002	December 2002	December 2003
<b>Implementation</b> ↑ ↓	(9) Develop Products and Services	↓	↓	↓	↓
	(10) Design Curriculum Models				
	(11) Present for Public Review				
	(12) State Board Review				
	(13) Adoption of Curriculum Models by State Board of Education				
(14) Deliver Curriculum Models	September 2003	September 2003	September 2004	September 2004	September 2005



# ACADEMIC CONTENT STANDARDS

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The Technology Team wishes to express their appreciation to the following Department staff members for their contributions to the development of the technology academic content standards: Pamela Hogans, Vicky Kelly, Jason Hanger in the Office of Curriculum and Instruction, and Sara Mazak, in the Office of Career Technical and Adult Education.

## Ohio's Technology Standards



### 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.*

### 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.

### 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.

# ACADEMIC CONTENT STANDARDS

## **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.

## **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.

## **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.

## **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.

# ACADEMIC CONTENT STANDARDS

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.*



Student participation in national or regional design challenges, technical performance contests, or in projects to design technology solutions to local community problems provides ways for elementary, middle and high school students to engage in experiences that are both rigorous and authentic.

# ACADEMIC CONTENT STANDARDS

## Ohio Technology Standards

## Technology-related National Standards

Ohio National Standards Correlation		AASL/AECT	ISTE	ITEA
		American Association of School Libraries & Association of Educational Communications and Technologies	International Society for Technology in Education	International Technology Education Association
Ohio's K-12 Technology Academic Content Standards	<p><b>Standard 1 Nature of Technology</b> Students develop an understanding of technology, its characteristics, scope, core concepts and relationships between technologies and other fields.</p>	Standards 4, 5, 6	Standard 1	Standards 1, 2, 3
	<p><b>Standard 2 Technology and Society Interaction</b> 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.</p>	Standards 7, 8, 9	Standard 2	Standards 4, 5, 6, 7
	<p><b>Standard 3 Technology for Productivity Applications</b> Students learn the operations of technology through the usage of technology and productivity tools.</p>	Standards 1, 2, 3	Standard 3	Standards 8, 9, 10
	<p><b>Standard 4 Technology for Communication Applications</b> Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.</p>	Standards 1, 2, 3, 4, 5, 6	Standard 4	Standards 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
	<p><b>Standard 5 Technology for Information Literacy</b> Students engage in information literacy strategies, use the Internet, technology tools and resource, and apply information-management skills to answer questions and expand knowledge.</p>	Standards 1, 2, 3	Standard 5	Standards 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
	<p><b>Standard 6 Design</b> Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.</p>	Standards 4, 5, 6	Standard 6	Standards 8, 9, 10, 11, 12, 13
	<p><b>Standard 7 Design World</b> 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.</p>	Standards 7, 8, 9	Standards 4, 5, 6	Standards 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

- Indicates direct alignment between Ohio Standards and technology-related national standards
- Indicates correlation between Ohio Standards and technology-related national standards
- Indicates connection between Ohio Standards and technology-related national standards

## National Education Technology Standards for Students

International Society for Technology in Education (ISTE-NETS Students) 2000

### 1. Basic Operations and Concepts:

- Students demonstrate a sound understanding of the nature and operation of technology systems;
- Students are proficient in the use of technology.

### 2. Social, Ethical, and Human Issues:

- Students understand the ethical, cultural, and societal issues related to technology;
- Students practice responsible use of technology systems, information, and software;
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits and productivity.

### 3. Technology Productivity Tools:

- Students use technology tools to enhance learning, increase productivity and promote creativity;
- Students use productivity tools to collaborate in constructing technology-enhanced models, preparing publications and producing other creative works.

### 4. Technology Communication Tools:

- Students use telecommunications to collaborate, publish and interact with peers, experts and other audiences;
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

### 5. Technology Research Tools

- Students use technology to locate, evaluate, and collect information from a variety of sources;
- Students use technology tools to process data and report results;
- Students evaluate and select new information resources and technological innovations based on the appropriateness to specific tasks.

### 6. Technology Problem-solving and Decision-making Tools:

- Students use technology resources for solving problems and making informed decisions;
- Students employ technology in the development of strategies for solving problems in the real world.



# ACADEMIC CONTENT STANDARDS

## Information Literacy Standards for Student Learning

American Association of School Librarians (AASL) and  
Association for Educational Communications and Technology (AECT) 1998

### Information Literacy

**Standard 1:** The student who is information literate accesses information efficiently and effectively.

**Standard 2:** The student who is information literate evaluates information critically and competently.

**Standard 3:** The student who is information literate uses information accurately and creatively.

### Independent Learning

**Standard 4:** The student who is an independent learner is information literate and pursues information related to personal interests.

**Standard 5:** The student who is an independent learner is information literate and appreciates literature and other creative expressions of information.

**Standard 6:** The student who is an independent learner is information literate and strives for excellence in information seeking and knowledge generation.

### Social Responsibility

**Standard 7:** The student who contributes positively to the learning community and to society is information literate and recognizes the importance of information to a democratic society.

**Standard 8:** The student who contributes positively to the learning community and to society is information literate and practices ethical behavior in regard to information and information technology.

**Standard 9:** The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information.





# ACADEMIC CONTENT STANDARDS

## Standards for Technological Literacy: Content for the Study of Technology

International Technology Education Association  
(ITEA) 2000

### The Nature of Technology

**Standard 1:** Students will develop an understanding of the characteristics and scope of technology.

**Standard 2:** Students will develop an understanding of the core concepts of technology.

**Standard 3:** Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

### Technology and Society

**Standard 4:** Students will develop an understanding of the cultural, social, economic, and political effects of technology.

**Standard 5:** Students will develop an understanding of the effects of technology on the environment.

**Standard 6:** Students will develop an understanding of the role of society in the development and use of technology.

**Standard 7:** Students will develop an understanding of the influence of technology on history.

### Design

**Standard 8:** Students will develop an understanding of the attributes of design.

**Standard 9:** Students will develop an understanding of engineering design.

**Standard 10:** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

### Abilities of a Technological World

**Standard 11:** Students will develop abilities to apply the design process.

**Standard 12:** Students will develop abilities to use and maintain technological products and systems.

**Standard 13:** Students will develop abilities to assess the impact of products and systems.

### The Designed World

**Standard 14:** Students will develop an understanding of and be able to select and use medical technologies.

**Standard 15:** Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

**Standard 16:** Students will develop an understanding of and be able to select and use energy and power technologies.

# ACADEMIC CONTENT STANDARDS

**Standard 17:** Students will develop an understanding of and be able to select and use information and communication technologies.

**Standard 18:** Students will develop an understanding of and be able to select and use transportation technologies.

**Standard 19:** Students will develop an understanding of and be able to select and use manufacturing technologies.

**Standard 20:** Students will develop an understanding of and be able to select and use construction technologies.



Designing and building devices to demonstrate technology systems content provides opportunities for students to experience first-hand concepts important to understanding and applying academic standards content and making real-world connections.

K-12 Technology

# Philosophy and Guiding Principles



# ACADEMIC CONTENT STANDARDS

## Philosophy and Guiding Principles

Ohio's technology academic content standards serve as a basis for what all students should know and be able to do by the time they graduate from high school. These standards, benchmarks and grade-level indicators are intended to provide Ohio's educators with a set of common expectations upon which to base technology curricula.

### Philosophy of Ohio's Technology Academic Content Standards

The standards represent technology knowledge, conceptual learning and skill development needed to make successful transitions through kindergarten through grade 12 to post-secondary education, the workplace, civic/ daily life and to support lifelong learning. Through the application of technical skills, knowledge, processes, and critical thinking skills, learners will become capable problem-solvers and creative thinkers who are prepared to adapt to changing environments, educational challenges and career opportunities. The philosophy of Ohio's technology standards is to ensure that all students become technologically literate through the understanding and use of technology. Specifically, technology:

- Helps students understand the nature of the technological world in which they live;
- Facilitates the acquisition, creation and dissemination of information;
- Increases career prospects and economic potential through the application of acquired technology knowledge, skills and abilities;
- Prepares students for their role as citizens and decision-makers in a diverse democratic society.



# ACADEMIC CONTENT STANDARDS

## Guiding Principles for Ohio's Technology Academic Content Standards

Ohio's technology academic content standards:

- Set high expectations for technology achievement by **all** students;
- Align with national technology standards;
- Represent technology knowledge, conceptual learning and skill development needed to make successful transitions through kindergarten through grade 12 to post-secondary education, the workplace, civic/ daily life and to support lifelong learning;
- Focus on important concepts across grade-levels through well-articulated benchmarks and grade-level indicators, resulting in a rigorous, increasingly more sophisticated program of technology studies;
- Encourage active and experiential learning that enables students to perform real-world tasks;
- Guide the development of kindergarten through grade 12 district technology curricula and instructional programs;
- Serve as the basis for district and classroom assessments.



# ACADEMIC CONTENT STANDARDS

## Technology for All

The Ohio Department of Education believes that Ohio's academic content standards are for all students. Clearly defined standards delineate what all children, college- and career-bound, should know and be able to do as they progress through the grade levels. Well-defined standards ensure that parents, teachers and administrators will be able to monitor students' development. Students, as stakeholders in their own learning, will be capable of tracking their own learning.

No individual or group should be excluded from the opportunity to learn and all students are presumed capable of learning. Every Ohio student, regardless of race, gender, ethnicity, socioeconomic status, limited English proficiency, disability or giftedness, shall have access to a challenging, standards-based curriculum.

The knowledge and skills defined in Ohio's academic content standards are within the reach of all students. Students, however, develop at different rates. All children learn and experience success given time and opportunity, but the degree to which the standards are met and the time it takes to reach them will vary from student to student.

Students with disabilities shall have Individualized Education Programs (IEPs) aligned with the standards. Students with disabilities are, first and foremost, students of the general curriculum, yet they may require specific supports and/or services to progress in the curriculum. These supports and services are not intended to compromise the content standards. Rather, they provide students with disabilities the opportunity to maximize their strengths, and participate and progress in the standards-based curriculum.

Students who can exceed the grade-level indicators and benchmarks set forth in the standards must be afforded the opportunity and be encouraged to do so. Students who are gifted may require special services or activities in order to fully develop their intellectual, creative, artistic and academic capabilities or to excel in a specific content area. Again, the point of departure is the standards-based curriculum.

Students with limited English proficiency (LEP) may also need specific supports and adaptive instructional delivery in order to achieve Ohio's academic content standards. An instructional delivery plan for a student with LEP needs to take into account the student's level of English language proficiency as well as his or her cultural experiences.

All children should be provided adjustments when necessary to address their individual needs. Identifying and nurturing their talents will enable all students to reach the standards.





K-12 Technology

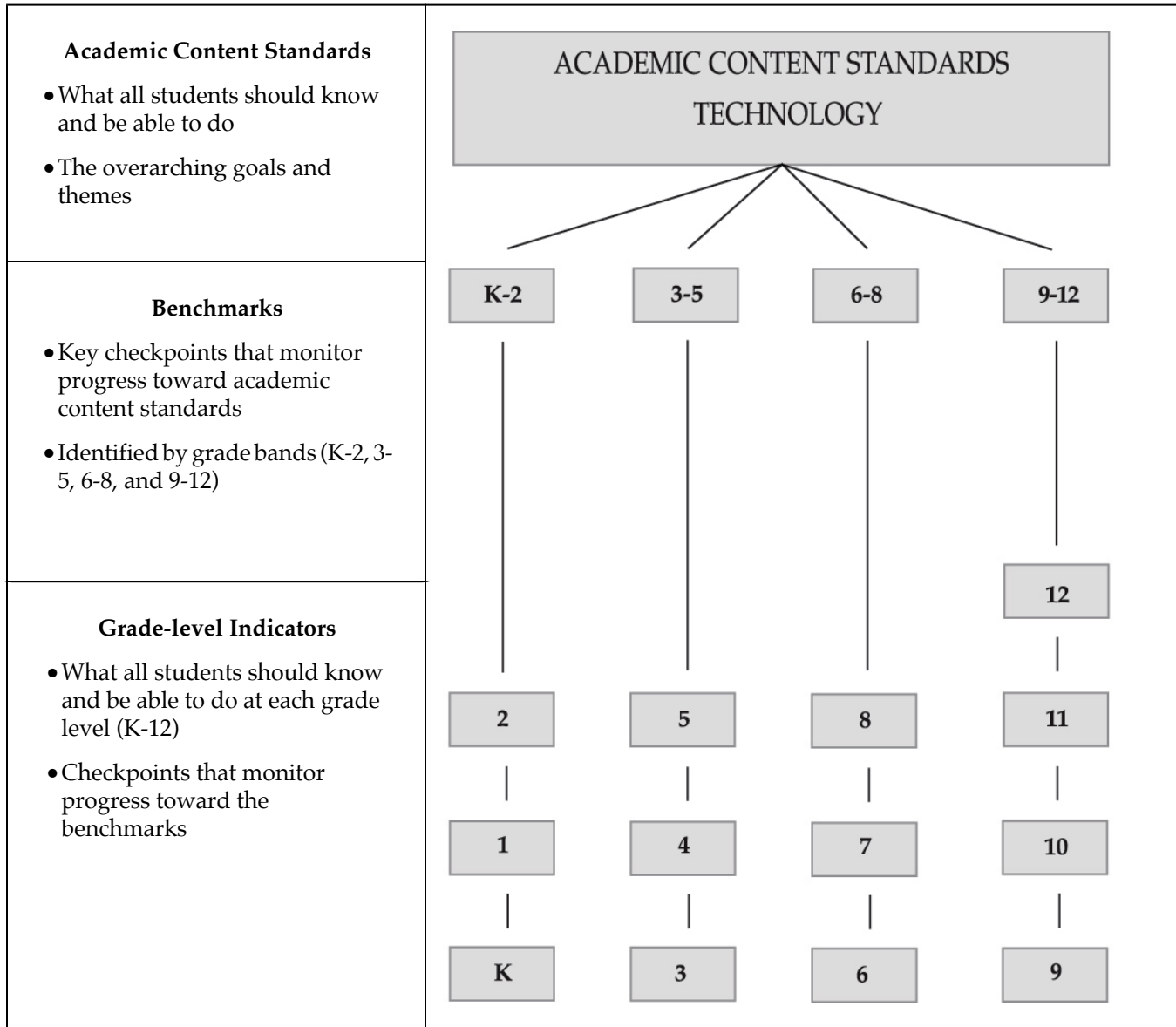
# Structure and Format





# ACADEMIC CONTENT STANDARDS

## Academic Content Standards Framework Technology K-12



# ACADEMIC CONTENT STANDARDS

## How to Read the Benchmarks by Standard Alignment

The benchmarks are key checkpoints that monitor student progress toward meeting the technology standards. Benchmarks are organized by standard. Readers will see a standard and narrative first, followed by the benchmarks that are aligned with that standard.

The diagram shows a page from an Academic Content Standards document. At the top, a black banner contains the text "ACADEMIC CONTENT STANDARDS". Below this, the page is divided into sections. A callout labeled "Standard" points to the heading "Standard 2: Technology and Society Interaction". A callout labeled "Standard Narrative" points to the paragraph describing the standard's purpose: "Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for... in responsible and ethical use of technology." A callout labeled "Grade Band" points to the heading "By the end of the 3-5 program:". Below this, a table of benchmarks is shown. A callout labeled "Benchmark" points to one of the items in the table: "A. Identify responsible citizenship relative to technology and its use." A callout labeled "Teacher Notes" points to the "Notes:" section at the bottom left of the page.

**ACADEMIC CONTENT STANDARDS**

**Standard**

**Benchmarks**

**Standard Narrative**

**Grade Band**

**Benchmark**

**Teacher Notes**

**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... in responsible and ethical use of technology.

Students learn that the interaction between society and technology has... and technology may have unintended consequences which may be helpful or harmful... in... of technology will affect the economy, ethical standards, environment and culture. Students evaluate impact of products or systems by gathering and synthesizing information, analyzing trends and drawing conclusions. Students analyze technological understanding and development and the implications of using technology. They... that support ethical decision-making and lifelong learning.

**By the end of the K-2 program:**

- A. Identify responsible citizenship relative to technology and its use.
- B. Recognize that technology has an interrelationship with the environment.
- C. Describe and demonstrate how technology has had an influence on our world.
- D. Collect information about products and discuss whether solutions create positive or negative results.

**By the end of the 3-5 program:**

- A. Define responsible citizenship relative to technology.
- B. Investigate and explain the interrelationship between technology and the environment throughout history.
- C. Explain and demonstrate the influence of technology throughout history.
- D. Practice responsible use of technology and understand school district guidelines for technology use, and explore technology ownership.
- E. Identify development patterns and influence of technology on the world.

Notes:

# ACADEMIC CONTENT STANDARDS

## How to Read the Benchmarks by Grade Band Alignment

The benchmarks are key checkpoints that monitor student progress toward meeting the technology standards. Benchmarks are organized by grade band. Readers will see the grade band first, followed by the standards and aligned benchmarks for that grade band.

**ACADEMIC CONTENT STANDARDS**

**Technology Benchmarks** Grade Band

By the end of the 6-8 program:

Standard 1 Nature of Technology	Standard 2 Technology and Society Interaction	Standard 3 Technology for Productivity Applications
<p><span style="border: 1px solid black; border-radius: 50%; padding: 2px;">Benchmark</span></p> <p>A. Analyze information relative to the characteristics of technology and apply in a practical setting.</p> <p>B. Apply the core concepts of technology in a practical setting.</p> <p>C. Analyze the relationships among technologies and explore the connections between technology and other fields of study.</p>	<p><span style="border: 1px solid black; border-radius: 50%; padding: 2px;">Standard</span></p> <p>A. Analyze technologically responsible citizenship.</p> <p>B. Describe and explain the impact of technology on the environment.</p> <p>C. Describe how design and invention have influenced technology throughout history.</p> <p>D. Articulate intellectual property issues related to technology and demonstrate appropriate, ethical and legal use of technology.</p> <p>E. Assess the impact of technological products and systems.</p>	<p>A. Demonstrate an understanding of concepts underlying hardware, software and connectivity.</p> <p>B. Select appropriate technology resources solve problems and support learning.</p> <p>C. Use productivity tools to produce creative work to prepare publications and to construct technology-enhanced models.</p>

6  
7  
8 Grade-Levels

**Notes:** Teacher Notes



# ACADEMIC CONTENT STANDARDS

## How to Read the Benchmarks and Indicators by Standard Alignment

This section of the document is organized by standard. Each standard is followed by a grade band. The benchmarks that monitor student progress are next, followed by the supporting indicators for that grade-level.

The diagram illustrates the organizational structure of the Academic Content Standards document. It shows a hierarchy from the overall title to specific indicators, with callouts identifying each level:

- ACADEMIC CONTENT STANDARDS** (Overall Title)
- Standard**: Standard 5: Technology and Information Literacy
- Grade Band**: Grades K-2
- Benchmark**: Benchmark A: State what information is, and show where it can be found.
- Organizer**: Kindergarten Understanding Information
- Grade-Level Indicator**: 1. Identify what information is, and recognize that it can be represented in a variety of ways (e.g., numbers, words, pictures, sounds).

Additional indicators shown include:

- Grade One Understanding Information: 1. Talk about the difference between what is real and what is not real (e.g., information and news).
- Grade Two Understanding Information: 1. Tell about the purposes for information use (e.g., inform, solve problems, find answers, learn).

# ACADEMIC CONTENT STANDARDS

## How to Read the Benchmarks and Indicators by Grade Band Alignment

This section of the document is organized by grade bands. Each standard is followed by benchmarks that monitor student progress. Below each benchmark are the supporting indicators for each grade-level in the grade band.

The diagram illustrates the structure of the Academic Content Standards document. It shows a hierarchy from the overall standards to specific grade-level indicators. Callouts identify key components: Standard, Benchmark, Grade-Level Indicator, and Organizer.

**ACADEMIC CONTENT STANDARDS**

**Grade-Bands** (K, 1, 2)

**Grades K-2** (Grade Band)

**Standard 3: Technology for Productivity Applications**

Students learn the operations of technology. Students use a range of technology and productivity tools to enhance their learning. Students understand and use appropriate technology tools 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.**

**Organizer**

**Kindergarten**  
Basic Concepts

**Grade One**  
Basic Concepts

**Grade Two**

**Grade-Level Indicators**

- 1. Locate computer and multimedia devices 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, printer).
- 3. Use computer and multimedia technology with teacher assistance (e.g., computer, VCR, listening station).

**Grade One Indicators**

- 1. Identify and use computer and multimedia technology by and terms used to describe it (e.g., computer, printer, VCR, DV).
- 2. Identify various parts of a computer by name (e.g., monitor, keyboard, power button, disk drive, CD/DVD drive).

**Grade Two Indicators**

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

K-12 Technology

# Benchmarks by Standard



# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.*

By the end of the K-2 program:	By the end of the 3-5 program:
A. Recognize the characteristics and scope of technology. B. Describe and give examples of technology's core concepts: systems, resources and processes. C. Describe the relationships among technologies, and the connections between technology and other fields of study.	A. Compare and discuss the characteristics of technology in our community. B. Identify, describe and discuss the core concepts of technology. C. Compare and discuss the relationships among technologies, and the connections between technology and other fields of study.

**Notes:**



# ACADEMIC CONTENT STANDARDS

By the end of the 6-8 program:	By the end of the 9-12 program:
<ul style="list-style-type: none"><li>A. Analyze information relative to the characteristics of technology and apply in a practical setting.</li><li>B. Apply the core concepts of technology in a practical setting.</li><li>C. Analyze the relationships among technologies and explore the connections between technology and other fields of study.</li></ul>	<ul style="list-style-type: none"><li>A. Synthesize information, evaluate and make decisions about technologies.</li><li>B. Apply technological knowledge in decision-making.</li><li>C. Examine the synergy between and among technologies and other fields of study when solving technological problems.</li></ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.

By the end of the K-2 program:	By the end of the 3-5 program:
<ul style="list-style-type: none"><li>A. Identify responsible citizenship relative to technology and its use.</li><li>B. Recognize that technology has an interrelationship with the environment.</li><li>C. Describe and demonstrate how technology has had an influence on our world.</li><li>D. Collect information about products and discuss whether solutions create positive or negative results.</li></ul>	<ul style="list-style-type: none"><li>A. Define responsible citizenship relative to technology.</li><li>B. Investigate and explain the interrelationships between technology and the environment.</li><li>C. Explain and demonstrate the influence of technology throughout history.</li><li>D. Practice responsible use of technology, understand school district guidelines for technology use, and explore technology ownership.</li><li>E. Identify development patterns and examine the influence of technology on the world.</li></ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

By the end of the 6-8 program:	By the end of the 9-12 program:
<ul style="list-style-type: none"> <li>A. Analyze technologically responsible citizenship.</li> <li>B. Describe and explain the impact of technology on the environment.</li> <li>C. Describe how design and invention have influenced technology throughout history.</li> <li>D. Articulate intellectual property issues related to technology and demonstrate appropriate, ethical and legal use of technology.</li> <li>E. Assess the impact of technological products and systems.</li> </ul>	<ul style="list-style-type: none"> <li>A. Interpret and practice responsible citizenship relative to technology.</li> <li>B. Demonstrate the relationship among people, technology and the environment.</li> <li>C. Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.</li> <li>D. Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.</li> <li>E. Forecast the impact of technological products and systems.</li> </ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.

By the end of the K-2 program:	By the end of the 3-5 program:
<ul style="list-style-type: none"><li>A. Understand basic computer and multimedia technology concepts and terminology.</li><li>B. Demonstrate operation of basic computer and multimedia technology tools.</li><li>C. Use productivity tools to produce creative works.</li></ul>	<ul style="list-style-type: none"><li>A. Understand computer and multimedia technology concepts and communicate using the correct terminology.</li><li>B. Use appropriate tools and technology resources to complete tasks and solve problems.</li><li>C. Use productivity tools to produce creative works and prepare publications.</li></ul>

Notes:

# ACADEMIC CONTENT STANDARDS

By the end of the 6-8 program:	By the end of the 9-12 program:
<ul style="list-style-type: none"><li>A. Demonstrate an understanding of concepts underlying hardware, software and connectivity.</li><li>B. Select appropriate technology resources to solve problems and support learning.</li><li>C. Use productivity tools to produce creative works, to prepare publications and to construct technology-enhanced models.</li></ul>	<ul style="list-style-type: none"><li>A. Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.</li><li>B. Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.</li></ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.

<b>By the end of the K-2 program:</b>	<b>By the end of the 3-5 program:</b>
A. Investigate the nature and operation of communication systems. B. Explore how information can be published and presented in different formats. C. Participate in group projects and learning activities using technology communications.	A. Identify the concepts and operations of communication systems. B. Develop, publish and present information in print and digital formats. C. Use technology communications to participate in online group collaborative interactive projects and activities.

**Notes:**

# ACADEMIC CONTENT STANDARDS

By the end of the 6-8 program:	By the end of the 9-12 program:
<p>A. Communicate information technologically and incorporate principles of design into the creation of messages and communication products.</p> <p>B. Develop, publish and present information in a format that is appropriate for content and audience.</p> <p>C. Select appropriate technology communication tools and design collaborative interactive projects and activities to communicate with others.</p>	<p>A. Apply appropriate communication design principles in published and presented projects.</p> <p>B. Create, publish and present information, utilizing formats appropriate to the content and audience.</p> <p>C. Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.</p>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.

By the end of the K-2 program:	By the end of the 3-5 program:
<ul style="list-style-type: none"><li>A. State what information is, and show where it can be found.</li><li>B. Use a simple research process model which includes deciding what to use, finding resources, using information and checking work to generate a product.</li><li>C. Apply basic browser and navigation skills to find information from the Internet.</li></ul>	<ul style="list-style-type: none"><li>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.</li><li>B. Use technology to find information by applying a research process to decide what information is needed, find sources, use information and check work.</li><li>C. Use the Internet to find, use and evaluate information.</li><li>D. Identify, access and use electronic resources from both free and fee-based Internet sources.</li></ul>

Notes:



# ACADEMIC CONTENT STANDARDS

By the end of the 6-8 program:	By the end of the 9-12 program:
<ul style="list-style-type: none"><li>A. Evaluate the accuracy, authority, objectivity, currency, coverage and relevance of information and data sources.</li><li>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.</li><li>C. Develop search strategies, retrieve information in a variety of formats and evaluate the quality and appropriate use of Internet resources.</li><li>D. Select, access and use appropriate electronic resources for a defined information need.</li></ul>	<ul style="list-style-type: none"><li>A. Determine and apply an evaluative process to all information sources chosen for a project.</li><li>B. Apply a research process model to conduct research and meet information needs.</li><li>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.</li><li>D. Evaluate choices of electronic resources and determine their strengths and limitations.</li></ul>

Notes:

# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.

By the end of the K-2 program:	By the end of the 3-5 program:
<ul style="list-style-type: none"><li>A. Identify problems and potential technological solutions.</li><li>B. Understand that changes in design can be used to strengthen or improve an object.</li><li>C. Explore how products are invented and repaired.</li></ul>	<ul style="list-style-type: none"><li>A. Describe and apply a design process to solve a problem.</li><li>B. Describe how engineers and designers define a problem, creatively solve it and evaluate the solution.</li><li>C. Understand the role of troubleshooting in problem-solving.</li></ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

<b>By the end of the 6-8 program:</b>	<b>By the end of the 9-12 program:</b>
<p>A. Evaluate the aesthetic and functional components of a design and identify creative influences.</p> <p>B. Recognize the role of engineering design and of testing in the design process.</p> <p>C. Understand and apply research, innovation and invention to problem-solving.</p>	<p>A. Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.</p> <p>B. Recognize the role of teamwork in engineering design and of prototyping in the design process.</p> <p>C. Understand and apply research, development and experimentation to problem-solving.</p>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Benchmarks

### 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.*

By the end of the K-2 program:	By the end of the 3-5 program:
A. Develop an understanding of the goals in physical technologies. B. Develop an understanding of the goals of informational technologies. C. Develop an understanding of the goals of bio-related technologies.	A. Develop an understanding of how physical technologies enhance our lives. B. Recognize appropriate modes of technical communication across technological systems. C. Develop an understanding of how bio-related technologies improve our lives.

Notes:

# ACADEMIC CONTENT STANDARDS

By the end of the 6-8 program:	By the end of the 9-12 program:
<p>A. Develop an understanding of, and be able to, select and use physical technologies.</p> <p>B. Develop an understanding of, and be able to, select and use informational technologies.</p> <p>C. Develop an understanding of how bio-related technologies have changed over time.</p>	<p>A. k Classify, demonstrate, examine, and appraise energy and power technologies.</p> <p>B. Classify, demonstrate, examine and appraise transportation technologies.</p> <p>C. Classify, demonstrate, examine and appraise manufacturing technologies.</p> <p>D. Classify, demonstrate, examine and appraise construction technologies.</p> <p>E. Classify, demonstrate, examine and appraise information and communication technologies.</p> <p>F. Classify, demonstrate, examine and appraise medical technologies.</p> <p>G. Classify, demonstrate, examine and appraise agricultural and related biotechnologies.</p>

**Notes:**

# ACADEMIC CONTENT STANDARDS

K-12 Technology

# Benchmarks by Grade Band





## Technology Benchmarks

By the end of the K-2 program:

Standard 1: Nature of Technology	Standard 2: Technology and Society Interaction	Standard 3: Technology for Productivity Applications
<ul style="list-style-type: none"> <li>A. Recognize the characteristics and scope of technology.</li> <li>B. Describe and give examples of technology's core concepts: systems, resources and processes.</li> <li>C. Describe the relationships among technologies, and the connections between technology and other fields of study.</li> </ul>	<ul style="list-style-type: none"> <li>A. Identify responsible citizenship relative to technology and its use.</li> <li>B. Recognize that technology has an interrelationship with the environment.</li> <li>C. Describe and demonstrate how technology has had an influence on our world.</li> <li>D. Collect information about products and discuss whether solutions create positive or negative results.</li> </ul>	<ul style="list-style-type: none"> <li>A. Understand basic computer and multimedia technology concepts and terminology.</li> <li>B. Demonstrate operation of basic computer and multimedia technology tools.</li> <li>C. Use productivity tools to produce creative works.</li> </ul>

**Notes:**

## Technology Benchmarks

By the end of the K-2 program:

K  
1  
2

<b>Standard 4 Technology and Communication Applications</b>	<b>Standard 5 Technology and Information Literacy</b>
<ul style="list-style-type: none"> <li>A. Investigate the nature and operation of communication systems.</li> <li>B. Explore how information can be published and presented in different formats.</li> <li>C. Participate in group projects and learning activities using technology communications.</li> </ul>	<ul style="list-style-type: none"> <li>A. State what information is, and show where it can be found.</li> <li>B. Use a simple research process model which includes deciding what to use, finding resources, using information and checking work to generate a product.</li> <li>C. Apply basic browser and navigation skills to find information from the Internet.</li> </ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

K

1

2

## Technology Benchmarks

By the end of the K-2 program:

<b>Standard 6: Design</b>	<b>Standard 7: Designed World</b>
<ul style="list-style-type: none"><li>A. Identify problems and potential technological solutions.</li><li>B. Understand that changes in design can be used to strengthen or improve an object.</li><li>C. Explore how products are invented and repaired.</li></ul>	<ul style="list-style-type: none"><li>A. Develop an understanding of the goals in physical technologies.</li><li>B. Develop an understanding of the goals of informational technologies.</li><li>C. Develop an understanding of the goals of bio-related technologies.</li></ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Technology Benchmarks

By the end of the 3-5 program:

Standard 1: Nature of Technology	Standard 2: Technology and Society Interaction	Standard 3: Technology for Productivity Applications
<ul style="list-style-type: none"> <li>A. Compare and discuss the characteristics of technology in our community.</li> <li>B. Identify, describe and discuss the core concepts of technology.</li> <li>C. Compare and discuss the relationships among technologies, and the connections between technology and other fields of study.</li> </ul>	<ul style="list-style-type: none"> <li>A. Define responsible citizenship relative to technology.</li> <li>B. Investigate and explain the interrelationships between technology and the environment.</li> <li>C. Explain and demonstrate the influence of technology throughout history.</li> <li>D. Practice responsible use of technology, understand school district guidelines for technology use, and explore technology ownership.</li> <li>E. Identify development patterns and examine the influence of technology on the world.</li> </ul>	<ul style="list-style-type: none"> <li>A. Understand computer and multimedia technology concepts and communicate using the correct terminology.</li> <li>B. Use appropriate tools and technology resources to complete tasks and solve problems.</li> <li>C. Use productivity tools to produce creative works and prepare publications.</li> </ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Technology Benchmarks

By the end of the 3-5 program:

<b>Standard 4 Technology and Communication Applications</b>	<b>Standard 5 Technology and Information Literacy</b>
<p>A. Identify the concepts and operations of communication systems.</p> <p>B. Develop, publish and present information in print and digital formats.</p> <p>C. Use technology communications to participate in online group collaborative interactive projects and activities.</p>	<p>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.</p> <p>B. Use technology to find information by applying a research process to decide what information is needed, find sources, use information and check work.</p> <p>C. Use the Internet to find, use and evaluate information.</p> <p>D. Identify, access and use electronic resources from both free and fee-based Internet sources.</p>

Notes:

3

4

5

# ACADEMIC CONTENT STANDARDS

## Technology Benchmarks

By the end of the 3-5 program:

<b>Standard 6: Design</b>	<b>Standard 7: Designed World</b>
<ul style="list-style-type: none"><li>A. Describe and apply a design process to solve a problem.</li><li>B. Describe how engineers and designers define a problem, creatively solve it and evaluate the solution.</li><li>C. Understand the role of troubleshooting in problem-solving.</li></ul>	<ul style="list-style-type: none"><li>A. Develop an understanding of how physical technologies enhance our lives.</li><li>B. Recognize appropriate modes of technical communication across technological systems.</li><li>C. Develop an understanding of how bio-related technologies improve our lives.</li></ul>

**Notes:**

3

4

5

# ACADEMIC CONTENT STANDARDS

## Technology Benchmarks

By the end of the 6-8 program:

Standard 1: Nature of Technology	Standard 2: Technology and Society Interaction	Standard 3: Technology for Productivity Applications
<ul style="list-style-type: none"> <li>A. Analyze information relative to the characteristics of technology and apply in a practical setting.</li> <li>B. Apply the core concepts of technology in a practical setting.</li> <li>C. Analyze the relationships among technologies and explore the connections between technology and other fields of study.</li> </ul>	<ul style="list-style-type: none"> <li>A. Analyze technologically responsible citizenship.</li> <li>B. Describe and explain the impact of technology on the environment.</li> <li>C. Describe how design and invention have influenced technology throughout history.</li> <li>D. Articulate intellectual property issues related to technology and demonstrate appropriate, ethical and legal use of technology.</li> <li>E. Assess the impact of technological products and systems.</li> </ul>	<ul style="list-style-type: none"> <li>A. Demonstrate an understanding of concepts underlying hardware, software and connectivity.</li> <li>B. Select appropriate technology resources to solve problems and support learning.</li> <li>C. Use productivity tools to produce creative works, to prepare publications and to construct technology-enhanced models.</li> </ul>

Notes:

6

7

8



## Technology Benchmarks

By the end of the 6-8 program:

<p><b>Standard 4 Technology and Communication Applications</b></p>	<p><b>Standard 5 Technology and Information Literacy</b></p>
<p>A. Communicate information technologically and incorporate principles of design into the creation of messages and communication products.</p> <p>B. Develop, publish and present information in a format that is appropriate for content and audience.</p> <p>C. Select appropriate technology communication tools and design collaborative interactive projects and activities to communicate with others.</p>	<p>A. Evaluate the accuracy, authority, objectivity, currency, coverage and relevance of information and data sources.</p> <p>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.</p> <p>C. Develop search strategies, retrieve information in a variety of formats and evaluate the quality and appropriate use of Internet resources.</p> <p>D. Select, access and use appropriate electronic resources for a defined information need.</p>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Technology Benchmarks

By the end of the 6-8 program:

<b>Standard 6: Design</b>	<b>Standard 7: Designed World</b>
<ul style="list-style-type: none"><li>A. Evaluate the aesthetic and functional components of a design and identify creative influences.</li><li>B. Recognize the role of engineering design and of testing in the design process.</li><li>C. Understand and apply research, innovation and invention to problem-solving.</li></ul>	<ul style="list-style-type: none"><li>A. Develop an understanding of, and be able to, select and use physical technologies.</li><li>B. Develop an understanding of, and be able to, select and use informational technologies.</li><li>C. Develop an understanding of how bio-related technologies have changed over time.</li></ul>

### Notes:

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## Technology Benchmarks

By the end of the 9-12 program:

Standard 1: Nature of Technology	Standard 2: Technology and Society Interaction	Standard 3: Technology for Productivity Applications
<ul style="list-style-type: none"> <li>A. Synthesize information, evaluate and make decisions about technologies.</li> <li>B. Apply technological knowledge in decision-making.</li> <li>C. Examine the synergy between and among technologies and other fields of study when solving technological problems.</li> </ul>	<ul style="list-style-type: none"> <li>A. Interpret and practice responsible citizenship relative to technology.</li> <li>B. Demonstrate the relationship among people, technology and the environment.</li> <li>C. Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.</li> <li>D. Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.</li> <li>E. Forecast the impact of technological products and systems.</li> </ul>	<ul style="list-style-type: none"> <li>A. Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.</li> <li>B. Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.</li> </ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

## Technology Benchmarks

By the end of the 9-12 program:

<b>Standard 4 Technology and Communication Applications</b>	<b>Standard 5 Technology and Information Literacy</b>
<p>A. Apply appropriate communication design principles in published and presented projects.</p> <p>B. Create, publish and present information, utilizing formats appropriate to the content and audience.</p> <p>C. Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.</p>	<p>A. Determine and apply an evaluative process to all information sources chosen for a project.</p> <p>B. Apply a research process model to conduct research and meet information needs.</p> <p>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.</p> <p>D. Evaluate choices of electronic resources and determine their strengths and limitations.</p>

**Notes:**

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## Technology Benchmarks

By the end of the 9-12 program:

Standard 6: Design	Standard 7: Designed World
<ul style="list-style-type: none"> <li>A. Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.</li> <li>B. Recognize the role of teamwork in engineering design and of prototyping in the design process.</li> <li>C. Understand and apply research, development and experimentation to problem-solving.</li> </ul>	<ul style="list-style-type: none"> <li>A. Classify, demonstrate, examine, and appraise energy and power technologies.</li> <li>B. Classify, demonstrate, examine and appraise transportation technologies.</li> <li>C. Classify, demonstrate, examine and appraise manufacturing technologies.</li> <li>D. Classify, demonstrate, examine and appraise construction technologies.</li> <li>E. Classify, demonstrate, examine and appraise information and communication technologies.</li> <li>F. Classify, demonstrate, examine and appraise medical technologies.</li> <li>G. Classify, demonstrate, examine and appraise agricultural and related biotechnologies.</li> </ul>

**Notes:**

# ACADEMIC CONTENT STANDARDS

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K-12 Technology

# Alignment of Benchmarks and Indicators by Standard



# ACADEMIC CONTENT STANDARDS

K

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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.*

## Grades K-2

**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).



# ACADEMIC CONTENT STANDARDS

**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).

*Processes*

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).
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).

# ACADEMIC CONTENT STANDARDS

K

*Connections*

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

1

**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).

2

# ACADEMIC CONTENT STANDARDS

## Grades 3-5

**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).

# ACADEMIC CONTENT STANDARDS

**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.

**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.

# ACADEMIC CONTENT STANDARDS

## **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.

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# ACADEMIC CONTENT STANDARDS

## Grades 6-8

**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.

# ACADEMIC CONTENT STANDARDS

**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.



# ACADEMIC CONTENT STANDARDS

**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.

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# ACADEMIC CONTENT STANDARDS

## Grades 9-12

**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 Research*

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.

# ACADEMIC CONTENT STANDARDS

*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.

# ACADEMIC CONTENT STANDARDS

## *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.

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# ACADEMIC CONTENT STANDARDS

K

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## 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.

## Grades K-2

**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.

# ACADEMIC CONTENT STANDARDS

K

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2

## 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).

# ACADEMIC CONTENT STANDARDS

K

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## 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 3-5

**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.

**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.

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# ACADEMIC CONTENT STANDARDS

## 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.

**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).

# ACADEMIC CONTENT STANDARDS

## *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.

# ACADEMIC CONTENT STANDARDS

## 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).

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# ACADEMIC CONTENT STANDARDS

## Grades 6-8

**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.

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# ACADEMIC CONTENT STANDARDS

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).

# ACADEMIC CONTENT STANDARDS

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

### *Acceptable Use*

## 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).

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# ACADEMIC CONTENT STANDARDS

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).



# ACADEMIC CONTENT STANDARDS

## *Environmental Health*

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

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# ACADEMIC CONTENT STANDARDS

## Grades 9-12

**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.

# ACADEMIC CONTENT STANDARDS

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.

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# ACADEMIC CONTENT STANDARDS

## 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.

**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.

# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

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.

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# ACADEMIC CONTENT STANDARDS

## 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.

## Grades K-2

**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).

# ACADEMIC CONTENT STANDARDS

K

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

1

## Kindergarten

*Responsible Usage*

1. Listen to directions and use proper care when handling computer and multimedia technology.

2

*Basic Operations*

2. Follow the correct order for turning computers and multimedia technology resources on and off with teacher assistance.

*Problem-solving*

3. Identify and use input (keyboard, mouse) and output (printer) devices to operate computer and multimedia technology tools with teacher assistance.

*Productivity Tools*

4. Use software programs with teacher assistance.

5. Discover that technology tools can help solve problems.

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).

*Basic Operations*

2. Turn computer and multimedia technology resources on and off.

3. Discuss software and why it is necessary to operate computer and multimedia technology.

*Problem-solving*

4. Start, use and exit software programs with teacher assistance.

*Beginning Keyboarding*

5. Use input (keyboard, mouse) and output (printer) devices to operate computer and multimedia technology tools with teacher assistance.

6. Use software programs designed to develop problem-solving skills.

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).



# ACADEMIC CONTENT STANDARDS

*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).

K

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# ACADEMIC CONTENT STANDARDS

## Grades 3-5

**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).

# ACADEMIC CONTENT STANDARDS

## 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).

# ACADEMIC CONTENT STANDARDS

## *Communication Tools*

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).
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 6-8

**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 superhighway / 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.

# ACADEMIC CONTENT STANDARDS

## *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).

# ACADEMIC CONTENT STANDARDS

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

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# ACADEMIC CONTENT STANDARDS

## Grades 9-12

**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.

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# ACADEMIC CONTENT STANDARDS

**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).

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# ACADEMIC CONTENT STANDARDS

K

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## 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.

## Grades K-2

**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).

# ACADEMIC CONTENT STANDARDS

## 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).

# ACADEMIC CONTENT STANDARDS

## Grades 3-5

**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).

# ACADEMIC CONTENT STANDARDS

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).

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# ACADEMIC CONTENT STANDARDS

**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).

# ACADEMIC CONTENT STANDARDS

## Grades 6-8

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

### Grade Six

*Communications*

*Principles of Design*

1. Explain that information is communicated for specific purposes.
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*

*Principles of Design*

*Multimedia Applications*

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).
2. Integrate advanced design features into communication products (e.g., background selection, framing, set design).
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.

# ACADEMIC CONTENT STANDARDS

## *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).



# ACADEMIC CONTENT STANDARDS

## *Evaluation*

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

# ACADEMIC CONTENT STANDARDS

## *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.).

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# ACADEMIC CONTENT STANDARDS

## Grades 9-12

**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).

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# ACADEMIC CONTENT STANDARDS

## 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.

## 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).

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# ACADEMIC CONTENT STANDARDS

**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.

# ACADEMIC CONTENT STANDARDS

## 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).

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# ACADEMIC CONTENT STANDARDS

## 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.

K

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## Grades K-2

**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.

# ACADEMIC CONTENT STANDARDS

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*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).

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## Grade One

2

*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.

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# ACADEMIC CONTENT STANDARDS

## Grades 3-5

**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).

# ACADEMIC CONTENT STANDARDS

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

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# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

## *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).

# ACADEMIC CONTENT STANDARDS

## 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.

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# ACADEMIC CONTENT STANDARDS

## Grades 6-8

**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.

6

7

8

# ACADEMIC CONTENT STANDARDS

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

*Check*

## 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.



# ACADEMIC CONTENT STANDARDS

- Use*
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).
  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).

**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.

# ACADEMIC CONTENT STANDARDS

## *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).

# ACADEMIC CONTENT STANDARDS

- Evaluating Sources*
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.
  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 9-12

**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.

9

10

11

12

# ACADEMIC CONTENT STANDARDS

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?).

# ACADEMIC CONTENT STANDARDS

## 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).

# ACADEMIC CONTENT STANDARDS

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

## *Evaluating Sources*

### **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.

# ACADEMIC CONTENT STANDARDS

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 9

### *Electronic Resources*

1. Integrate search strategies within the electronic resource that targets retrieval for specific information need (e.g., limit by date of publication, focus on specific format such as image, sound file).
2. Review strengths and weaknesses of various types of electronic resources for research need (e.g., compare subject-specific magazine database to general online index of articles).
3. Demonstrate the difference between databases, directories and database archives (e.g., free vs. fee-based, delivery mechanism, such as CD, DVD, network, Internet, and general vs. specific discipline).
4. Select a specific database for an assignment and explain why it is the appropriate one to use (e.g., in researching a particular author, use a literary database of biographical and critical information about writers).

## 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).

## 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.

9

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12



# ACADEMIC CONTENT STANDARDS

## 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

K

1

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.

## Grades K-2

**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).

# ACADEMIC CONTENT STANDARDS

*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).

# ACADEMIC CONTENT STANDARDS

K

*Technical Communication*

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

## Grade One

1

*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).

2

## 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.

# ACADEMIC CONTENT STANDARDS

## Grades 3-5

**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.

3

4

5

# ACADEMIC CONTENT STANDARDS

## *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).

# ACADEMIC CONTENT STANDARDS

*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).

# ACADEMIC CONTENT STANDARDS

- 
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?).

3

4

5



# ACADEMIC CONTENT STANDARDS

## Grades 6-8

**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).

# ACADEMIC CONTENT STANDARDS

- 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).

6

## 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).

7

8

# ACADEMIC CONTENT STANDARDS

**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.

**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).

# ACADEMIC CONTENT STANDARDS

*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.

# ACADEMIC CONTENT STANDARDS

## Grades 9-12

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

### Grade Nine

#### *Design Process*

1. Explain and apply the methods and tools of inventive problem-solving to develop and produce a product or system.
2. Define simulation in the design process.

#### *Technical Contradictions*

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

#### *Requirements*

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

#### *Optimization and Trade-offs*

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

#### *Technical Problem-solving*

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

#### *Technical Communication*

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

#### *Intellectual Property*

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

#### *Understanding Technological Systems*

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

### Grade Ten

#### *Design Process*

1. Solve an inventive problem that contains a technical contradiction (e.g., analyze the technical system, state the technical contradiction and resolve the technical contradiction).
2. Apply common statistical tools to solve problems (e.g., statistical process control).
3. Describe quality and how it is evaluated in a product or system.

# ACADEMIC CONTENT STANDARDS

- Technical Contradictions*
- Requirements*
- Optimization and Trade-offs*
- Technology Transfer*
- History of Design*
- Intellectual Property*
- Grade Eleven**
- Design Process*
- Technical Contradictions*
- Universal Design*
4. Select and use simulation in the design process.
  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).
  6. Discuss how requirements of a design, such as criteria, constraints and efficiency, sometimes compete with each other.
  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).
  8. Understand the role of outsourcing in the engineering process and how effective communication is essential.
  9. Describe several systems archetypes and how they explain the behavior of systems.
  10. Describe how trademarks, patents and copyrights are obtained.
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.
  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).
  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.

# ACADEMIC CONTENT STANDARDS

## *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.



# ACADEMIC CONTENT STANDARDS

## *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?).

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# ACADEMIC CONTENT STANDARDS

- Engineering Practice*
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.
- Technical Communication*
7. Identify where statistical tools might be used to identify problems in a system.
  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.

# ACADEMIC CONTENT STANDARDS

- Engineering Design*
- Technical Communication*
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).
  5. Explain how the process of engineering design takes into account a number of factors including the interrelationship between systems.
  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).

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# ACADEMIC CONTENT STANDARDS

## *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.

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# ACADEMIC CONTENT STANDARDS

K

1

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.*

## Grades K-2

**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).

# ACADEMIC CONTENT STANDARDS

- 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).

# ACADEMIC CONTENT STANDARDS

K

1

2

## 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).

# ACADEMIC CONTENT STANDARDS

## Grades 3-5

**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.

# ACADEMIC CONTENT STANDARDS

- Manufacturing*
4. Describe how personnel in transportation technology are trained (e.g., apprenticeship, flight school, maritime school).
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.



# ACADEMIC CONTENT STANDARDS

*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.

3

4

5

# ACADEMIC CONTENT STANDARDS

## Grades 6-8

**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).

#### *Manufacturing*

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

# ACADEMIC CONTENT STANDARDS

## *Manufacturing*

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).
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.

# ACADEMIC CONTENT STANDARDS

## *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.

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

6

## **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.

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## **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).

# ACADEMIC CONTENT STANDARDS

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 Biotechnologies*

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.

# ACADEMIC CONTENT STANDARDS

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.
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.

### *Agriculture and Related Biotechnologies*

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# ACADEMIC CONTENT STANDARDS

## Grades 9-12

**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.

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# ACADEMIC CONTENT STANDARDS

- Safety*
- Engineering Practice*
- Use and Maintain Technological Systems*
2. Understand that all energy delivery systems need an infrastructure (e.g., identify features of natural gas and gasoline pipeline distribution systems across Ohio).
  3. Safely use the tools and processes of energy and power technological systems.
  4. Explain the relationship between resistance, voltage and current (Ohm's Law).
  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*
- Engineering Practice*
- Use and Maintain Technological Systems*
1. Classify energy-using devices and systems into the major forms: thermal, radiant, electrical, mechanical, chemical, nuclear and acoustic.
  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.
  4. Build and operate a transportation device (e.g., a magnetic levitation vehicle, a CO<sub>2</sub> 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).

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# ACADEMIC CONTENT STANDARDS

## *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).

**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 Application*

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

# ACADEMIC CONTENT STANDARDS

## 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).

**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.

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# ACADEMIC CONTENT STANDARDS

## 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).

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# ACADEMIC CONTENT STANDARDS

## 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.

*Design Applications*

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

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).

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# ACADEMIC CONTENT STANDARDS

- Use and Maintain Technological Systems*
2. Identify and investigate modern production technology practices and equipment in construction technologies (e.g., new building techniques, materials, tools).
  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).

# ACADEMIC CONTENT STANDARDS

## *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.

### *Emerging Technology*

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.



# ACADEMIC CONTENT STANDARDS

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).

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# ACADEMIC CONTENT STANDARDS

**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 Applications*

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.

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# ACADEMIC CONTENT STANDARDS

## 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.

### *Technical Standards*

2. Classify the ways medical technologies are regulated.
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.

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# ACADEMIC CONTENT STANDARDS

## 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).

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K-12 Technology

# Alignment of Benchmarks and Indicators by Grade Band



# ACADEMIC CONTENT STANDARDS

K

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## 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).

# ACADEMIC CONTENT STANDARDS

**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).

# ACADEMIC CONTENT STANDARDS

K

*Connections*

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

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**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).

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# ACADEMIC CONTENT STANDARDS

## Grades K-2

K

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### 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.

# ACADEMIC CONTENT STANDARDS

K

## 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.

1

## 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).

2

**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).



# ACADEMIC CONTENT STANDARDS

## 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).

K

1

2

## 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).

# ACADEMIC CONTENT STANDARDS

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

## 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.

### *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).

# ACADEMIC CONTENT STANDARDS

K

*Beginning Keyboarding*

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

1

**Benchmark C:** Use productivity tools to produce creative works.

2

## **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).

# ACADEMIC CONTENT STANDARDS

## Grades K-2

K

1

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).

# ACADEMIC CONTENT STANDARDS

K

*Communication Tools*

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

1

**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).

2

*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

K  
1  
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.

# ACADEMIC CONTENT STANDARDS

K

*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).

1

## Grade One

2

*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.

K

1

2

## 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).

# ACADEMIC CONTENT STANDARDS

*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).

# ACADEMIC CONTENT STANDARDS

K

*Technical Communication*

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

## **Grade One**

1

*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).

2

## **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.

# ACADEMIC CONTENT STANDARDS

## Grades K-2

K

1

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).

# ACADEMIC CONTENT STANDARDS

K

*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).

1

*Manufacturing*

4. Name products that are produced in large quantities (e.g., candy, baseballs, cars).

2

*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).

# ACADEMIC CONTENT STANDARDS

## 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).

# ACADEMIC CONTENT STANDARDS

## 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



# ACADEMIC CONTENT STANDARDS

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.

*Creating Technology*

3. Demonstrate the use of technology in daily life, noting the advantages and disadvantages those uses provide.

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).

*Processes*

2. Describe different properties of materials: color, weight, mass, hardness, temperature.

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.

3

## 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).

4

## Grade Five

### *Connections*

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

5

# 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.

3

4

5

### 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.

# 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.

# ACADEMIC CONTENT STANDARDS

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).

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# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

- Problem-solving*
- Productivity Tools*
- Keyboarding*
- Grade Four**
- Basic Concepts*
- Basic Operations*
- Problem-solving*
- Productivity Tools*
- Keyboarding*
- Grade Five**
- Basic Concepts*
- Basic Operations*
- Productivity Tools*
- Research Tools*
- Keyboarding*
4. Use technologies for particular content areas (e.g., calculators for math, computerized microscopes for science and books on CD-ROM for language arts).
  5. Show how you can find answers to problems by using electronic resources including the Internet.
  6. Tell a story using presentation software.
  7. Touch-type letters on the keyboard with both hands (e.g., begin to learn how to type/keyboard, use continuous keystrokes).
1. Explain how input and output devices operate and interact with computers and multimedia technology resources.
  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).
  6. Demonstrate how technology productivity tools can be used to help understand data.
  7. Collect/ create digital images and sounds related to a particular topic.
  8. Demonstrate appropriate keyboarding skills.
1. Describe how networks are used to access, share and store information (e.g., software, printers, folders, files).
  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?).
  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.
  5. Investigate technology tools used for researching problems and acquiring information and data.
  6. Use appropriate hand/ finger positions to key all letters (e.g., demonstrate ability to appropriately keyboard and assess accuracy).



# ACADEMIC CONTENT STANDARDS

**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).

### *Communication Tools*

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).

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# 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).

# ACADEMIC CONTENT STANDARDS

**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).

# ACADEMIC CONTENT STANDARDS

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.

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## 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).

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## 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).

# ACADEMIC CONTENT STANDARDS

## 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.).

# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

- 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.

# ACADEMIC CONTENT STANDARDS

## *Web Site Evaluation*

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

### *Web Site Evaluation*

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



# ACADEMIC CONTENT STANDARDS

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.

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# ACADEMIC CONTENT STANDARDS

## 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

# ACADEMIC CONTENT STANDARDS

- (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:
- Energy and power;
  - Transportation;
  - Manufacturing;
  - Construction;
  - Information and communication;
  - Medical;
  - 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).

# ACADEMIC CONTENT STANDARDS

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?).

# ACADEMIC CONTENT STANDARDS

## *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?).

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# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

## *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.

# ACADEMIC CONTENT STANDARDS

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.



# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

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.

# ACADEMIC CONTENT STANDARDS

## 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

# ACADEMIC CONTENT STANDARDS

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.

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# 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.

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# ACADEMIC CONTENT STANDARDS

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.

# ACADEMIC CONTENT STANDARDS

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

### *Acceptable Use*

## 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?).

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# ACADEMIC CONTENT STANDARDS

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).



# ACADEMIC CONTENT STANDARDS

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).

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# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

## *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).

# ACADEMIC CONTENT STANDARDS

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.

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# 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?).

# ACADEMIC CONTENT STANDARDS

## *Principles of Design*

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.
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.

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## **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).

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## **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.

# ACADEMIC CONTENT STANDARDS

## 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).

# ACADEMIC CONTENT STANDARDS

## *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.).

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# 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?).

# ACADEMIC CONTENT STANDARDS

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).

# ACADEMIC CONTENT STANDARDS

*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).

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# 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).

# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

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

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# 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).

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# ACADEMIC CONTENT STANDARDS

*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).



# ACADEMIC CONTENT STANDARDS

- 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.

# ACADEMIC CONTENT STANDARDS

*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.

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# ACADEMIC CONTENT STANDARDS

## 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).

*Manufacturing*

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

# ACADEMIC CONTENT STANDARDS

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

# ACADEMIC CONTENT STANDARDS

## 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.

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# 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.

# ACADEMIC CONTENT STANDARDS

## *Agriculture and Related Biotechnologies*

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

## *Agriculture and Related Biotechnologies*

## **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.
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.

## *Agriculture and Related Biotechnologies*



# ACADEMIC CONTENT STANDARDS

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

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# 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.

# ACADEMIC CONTENT STANDARDS

- 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.

# ACADEMIC CONTENT STANDARDS

*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.

# ACADEMIC CONTENT STANDARDS

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

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# ACADEMIC CONTENT STANDARDS

## 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

# ACADEMIC CONTENT STANDARDS

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).

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# ACADEMIC CONTENT STANDARDS

**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.

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# 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.

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# ACADEMIC CONTENT STANDARDS

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.

# ACADEMIC CONTENT STANDARDS

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.

# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

**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).

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# ACADEMIC CONTENT STANDARDS

## 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?).

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# ACADEMIC CONTENT STANDARDS

## 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.

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# 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).



# ACADEMIC CONTENT STANDARDS

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.

# ACADEMIC CONTENT STANDARDS

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.

# ACADEMIC CONTENT STANDARDS

*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.

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# ACADEMIC CONTENT STANDARDS

*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).

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# ACADEMIC CONTENT STANDARDS

## *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).

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# 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).



# ACADEMIC CONTENT STANDARDS

## *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).

# ACADEMIC CONTENT STANDARDS

## *Technical Contradictions*

3. Interpret plans, diagrams and working drawings in the construction of a prototype.
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).

# ACADEMIC CONTENT STANDARDS

## *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.

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# ACADEMIC CONTENT STANDARDS

## *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.

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# ACADEMIC CONTENT STANDARDS

## *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 Communication*

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.

# ACADEMIC CONTENT STANDARDS

## *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.

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# 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).

# ACADEMIC CONTENT STANDARDS

## *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.

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# ACADEMIC CONTENT STANDARDS

## *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<sub>2</sub> 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).

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# 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).

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# 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.

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# ACADEMIC CONTENT STANDARDS

## 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.

# ACADEMIC CONTENT STANDARDS

- 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).

# ACADEMIC CONTENT STANDARDS

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|---|---|
| <i>Design Applications</i>                    | 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).  |
| <i>Emerging Technology</i>                    | 4. Describe the factors that influence the selection of technological products and systems in construction technologies (e.g., function, cost, aesthetics).   |
|   | 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).  |
| <b>Grade Twelve</b>                           |   |
| <i>Engineering Practice</i>                   | 1. Calculate quantitatively the resultant forces for live loads and dead loads.   |
| <i>Use and Maintain Technological Systems</i> | 2. Create a product (or prototype) or system in construction technologies using the appropriate technological tools, machines, equipment and technical processes.   |
| <i>Design Applications</i>                    | 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).   |
| <i>Technical Standards</i>                    | 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

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| <i>Technical Careers</i>                      | 1. Describe the careers available in information and communication technological systems and the training needed to pursue them.  |
| <i>Safety</i>                                 | 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). |
| <i>Use and Maintain Technological Systems</i> | 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   |



# ACADEMIC CONTENT STANDARDS

—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).
5. Describe the factors that influence the cost of producing technological products and systems in information and communication technologies.
6. Investigate emerging (state-of-the-art) and innovative applications of information and communication technology.

## *Design Applications*

## *Emerging 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

# ACADEMIC CONTENT STANDARDS

- Design Applications*
- and satellite phones, smart phones, TVs, radios, computers, fax machines, PDAs, mobile communicators).
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.



# ACADEMIC CONTENT STANDARDS

*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).

# ACADEMIC CONTENT STANDARDS

## *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).

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K-12 Technology

# Instructional Commentary



# Technology Foundations



The Ohio technology standards provide a basic understanding of technology including how to use technology tools to enhance teaching and learning, acquire and communicate information, solve problems and design solutions.

The Secretary's Commission on Achieving Necessary Skills (SCANS) was one of the first governmental entities to identify reasons why the study of technology in K-12 schools is important. The SCANS committee was charged with determining the skills that young people need in order to succeed in the world of work. They found that "high performance workplaces require competent workers who have the ability to manage resources, work amicably and productively with others, acquire and use information, master complex systems and work with a variety of technologies" (SCANS 1991).

Learning basic technology competencies is important for all students—those who directly enter the workforce and those who pursue higher education. "Accountants and engineers manage resources, information, systems, and technologies—both require competence in these areas even though balancing a set of books has little to do with building a bridge" (SCANS 1991). The application of technology may differ by profession or field of study, but foundation level knowledge, skills and abilities form the basis for success.



The U.S. Department of Education has produced two national education technology plans. A third plan is being developed and is expected to be published during the 2004-2005 school year. The first plan, *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge* (1996), reinforced competencies expressed by the SCANS committee.

"Technology increases students' learning opportunities, motivation, and achievement; it helps students to acquire skills that are rapidly becoming essential in the workplace; and it breaks the barriers of time and place, enabling students in any community, no matter how remote or impoverished, to have access to high-quality instruction" (U.S. DOE 1996). The plan also identified technological literacy as the "new basic" or the "Fourth R" along with reading, writing and arithmetic.

# ACADEMIC CONTENT STANDARDS

Goals of the first national education technology plan specified that:

- All teachers in the nation will have the training and support they need to help students learn to use computers and the information superhighway;
- All teachers and students will have modern, multimedia computers in their classrooms;
- Every classroom will be connected to the information superhighway;
- Effective software and online learning resources will be an integral part of every school's curriculum.



The second national education technology plan, *e-Learning: Putting a World-Class Education at the Fingertips of All Children (2000)*, stated that "a meaningful unified approach to providing students with the skills they will need for their futures must be more than a checklist of isolated technology skills, such as knowing the parts of a computer, writing drafts and final products with a word processor, or searching for information using a CD-ROM database" (U.S. DOE 2000). The second technology plan identified five new goals:

- Goal 1: All students and teachers will have access to information technology in their classrooms, schools, communities and homes;
- Goal 2: All teachers will use technology effectively to help students achieve high academic standards;
- Goal 3: All students will have technology and information literacy skills;
- Goal 4: Research and evaluation will improve the next generation of technology applications for teaching and learning;
- Goal 5: Digital content and networked applications will transform teaching and learning;

The second technology plan defined the purpose of achieving technology and information literacy on both an individual and societal level:

- Individual level- technology and information literacy skills will help consumers better *assess products* and make more intelligent *buying decisions*;
- Societal level- technology and information literacy skills will help citizens make better *decisions* through heightened understanding of the *scientific and technological foundations* of many *public policy issues* facing the nation and the world.



*The second national technology plan defined information literacy as:*

- *Task definition;*
- *Information seeking strategies;*
- *Location and access;*
- *Use of information;*
- *Synthesis;*
- *Evaluation.*

US. DOE, 2000

# ACADEMIC CONTENT STANDARDS



No Child Left Behind (NCLB) charges the Secretary of Education with developing the nation's third National Education Technology Plan. The plan will establish a national strategy supporting the effective use of technology to improve student academic achievement and to prepare students for the 21st century. The U.S. Department of Education, Office of Education Technology has established a Web site ([www.nationaledtechplan.org](http://www.nationaledtechplan.org)) "to help facilitate the development of the new technology plan" (U.S. DOE 2003).

The U.S. Department of Education views technology as having the capability to be a "transforming" tool, enabling organizations and individuals to gain significant advantages in work and life. Increased access to technology alone will not fundamentally transform education. It will take a willingness to explore the changes that must occur around technology to create the environments that best support its use. The U.S. DOE Technology Office is taking feedback via its Web site ([www.nationaledtechplan.org](http://www.nationaledtechplan.org)) from interested parties regarding needs or concerns that should be addressed in the new national technology plan (U.S. DOE 2003).

The State Education Technology Directors Association (SETDA) has identified strategies for implementing NCLB and assessing technology competence that may be found in the *SETDA National Leadership Institute Toolkit: States Helping States Implement No Child Left Behind* (SETDA, December 2002).

The toolkit states that the, "long-term goal of technology literacy is for students to use the tools of their society with skill; in an ethical, accurate, and insightful manner to meet the demands of the 21st Century workplace" (SETDA, December 2002).

## National Organizations

Standards from four national organizations, the International Society for Technology in Education (ISTE), the Association for Educational Communications and Technology (AECT), the American Association of School Librarians (AASL), and the International Technology Education Association (ITEA) informed the development of Ohio's technology standards.

ISTE states, "Our educational system must produce technology capable kids" (ISTE 2003). ISTE has developed a comprehensive set of national education technology standards referred to as NETS. The NETS project first established the *National Education Technology Standards (NETS) for Students* as a framework to provide educators with information about new learning environments where students could use technology to enhance their learning. The standards and performance indicators identify technology skills and conceptual knowledge which students should acquire and apply to curricular areas (ISTE 2003).

*"All students must be able to use technology effectively to Live, Learn, and Work successfully in an increasingly complex and information-rich society."*

ISTE 2000

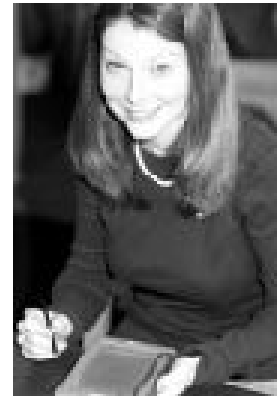


# ACADEMIC CONTENT STANDARDS

Effective educational technology use can enable *all students to become:*

- Capable information technology users;
- Information-seekers, analyzers, and evaluators;
- Problem solvers and decision makers;
- Creative and effective users of productivity tools;
- Communicators, collaborators, publishers, and producers;
- Informed, responsible, and contributing citizens.

(ISTE 2000)



ISTE next created the *National Education Technology Standards (NETS) for Teachers* ([cnets.iste.org/teachers](http://cnets.iste.org/teachers)) which describe the abilities that teachers need to create learning environments for students to become technology-capable. *NETS for Teachers* was followed by the *National Education Technology Standards (NETS) for Administrators* ([cnets.iste.org/administrators](http://cnets.iste.org/administrators)), the goal of which was to identify abilities that administrators should have to be leaders in a technology-rich environment.

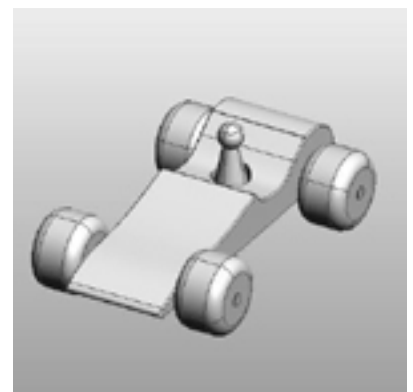
The American Association of School Librarians (AASL) and Association for Educational Communications and Technology (AECT) collaborated to create *Information Power: Building Partnerships for Learning* which includes the National Information Literacy Standards for Student Learning. (AASL/AECT 1998).



"The information explosion has provided countless opportunities for students and has dramatically altered the knowledge and abilities they will need to live productively in the twenty-first century. Students must become skillful consumers and producers of information in a range of sources and formats to thrive personally and economically in the communication age."

(AASL/AECT 1998, p. 2)

The International Technology Education Association (ITEA) is a professional association for technology education teachers who teach a curriculum called "technology education," which focuses on problem-based authentic learning utilizing mathematics, science and technology principles (ITEA 2003).



# ACADEMIC CONTENT STANDARDS

Technological studies involve:

- Designing, developing, and utilizing technological systems;
- Open-ended, problem-based design activities;
- Cognitive, manipulative, and effective learning strategies;
- Applying technological knowledge and processes to real world experiences using up-to-date resources;
- Working individually as well as in a team to solve problems.

(ITEA 2003)



ITEA worked in partnership with the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) to develop the Technology for All Americans Project. *Technology for All Americans: A Rationale and Structure for the Study of Technology* (ITEA 1996), addresses issues such as: "What does every student need to know and be able to do with technology? How should the articulated program in technology from Grades K-12 be organized? Is there a structure for teaching technology that can withstand the accelerating changes in our technological environment?" (ITEA 2003).

ITEA next published *Standards for Technological Literacy: Content for the Study of Technology (STL)*, which identifies content that will help students become technologically literate. The content includes knowledge, abilities, and the capacity to apply both knowledge and abilities to the real world (ITEA 2000). This was followed by *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards* (ITEA 2003).

## Resources:

American Association of School Librarians and Association for Educational Communications and Technology. *Information Power: Building Partnerships for Learning*. Chicago, Ill.: American Library Association, 1998.

International Society for Technology in Education (ISTE). *National Educational Technology Standards: Connecting Curriculum and Technology*. Washington, D.C.: International Society for Technology in Education, 2000.

International Society for Technology in Education (ISTE). *National Education Technology Standards for Administrators*. 2003. [cnets.iste.org/administrators](http://cnets.iste.org/administrators).

International Society for Technology in Education (ISTE). *National Education Technology Standards for Students*. 2000. [cnets.iste.org/students](http://cnets.iste.org/students).

International Society for Technology in Education (ISTE). *National Education Technology Standards for Teachers*. 2000. [cnets.iste.org/teachers](http://cnets.iste.org/teachers).

International Society for Technology in Education (ISTE). *ISTE Web Site*. 2003. [cnets.iste.org/intro](http://cnets.iste.org/intro).





# ACADEMIC CONTENT STANDARDS

International Technology Education Association (ITEA). *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development and Program Standards*. Reston, Virginia: International Technology Education Association, 2003.

International Technology Education Association (ITEA). *Standards for Technological Literacy: Content for the Study of Technology*. Reston, Virginia: International Technology Education Association, 2000.

International Technology Education Association (ITEA). *Technology for All Americans: A Rationale and Structure for the Study of Technology*. Reston, Virginia: International Technology Education Association, 1996.

Secretary's Commission on Achieving Necessary Skills (SCANS 2000). 1991, [www.scans.jhu.edu/default.htm](http://www.scans.jhu.edu/default.htm).

State Education Technology Directors Association. *SETDA National Leadership Institute Toolkit - States Helping States Implement No Child Left Behind*. (Definition, criteria and models section), 2003. [www.setda.org](http://www.setda.org).

U.S. Department of Education. Office of Educational Technology. *e-Learning: Putting a World-Class Education at the Fingertips of All Children*. Washington, D.C.: U.S. Department of Education, 2000.

U.S. Department of Education. Office of Educational Technology. *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge*. Washington, D.C.: U.S. Department of Education, 1996.

U.S. Department of Education. Office of Educational Technology Web Page, Initiatives: National Tech Plan, 2003. [www.ed.gov/about/offices/list/os/technology/inits\\_current.html](http://www.ed.gov/about/offices/list/os/technology/inits_current.html).



# Making Technology Connections Across Standards and Disciplines



"Growing up is about learning. The Net Generation are beginning to process information and learn differently than the boomers..."

The destination is different and so is the route the kids must take"

Don Tapscot, *Growing Up Digital*

The technology academic content standards can be interwoven into each curricular discipline. The purpose of integrating technology is to help students make realistic connections between what they learn in each content area and the real world.

"Curriculum integration with the use of technology involves the infusion of technology as a tool to enhance learning in a content area or multidisciplinary setting. The technology enables students to learn in ways not previously possible" (ISTE 2000).

Although the technology standards are printed in a linear fashion, they should be taught in an integrated style. Multiple standards, benchmarks and indicators may be addressed in one lesson or unit. The knowledge, skills and abilities featured within the individual technology standards are interconnected across all of the technology standards. These concepts may be integrated into other subject areas or taught in partnership with teachers of other academic content areas. Technology lends itself to curriculum integration, team teaching and multidisciplinary instruction such as MST—mathematics, science and technology.

Student experiences designed to focus on these relationships will help build interconnected knowledge. An interdisciplinary curriculum cuts across subject-matter lines to focus on comprehensive world issues that bring together the various segments of the curriculum into meaningful association. This provides coherence and allows student experiences to add up to more than just a miscellaneous collection of topics or activities (American Association of Advancement of Science 1993).

There is a body of research related to how children learn that supports an interdisciplinary curriculum. "The brain may resist learning

*"By building on the best of current practice, standards aim to take us beyond the constraints of present structures of schooling toward a shared vision of excellence"*  
National Research Council,  
p. 10.

# ACADEMIC CONTENT STANDARDS

fragmented facts that are presented in isolation. Learning is believed to occur faster and more thoroughly when it is presented in meaningful contexts, with an experiential component. Put to use in the classroom, the brain research points toward interdisciplinary learning, thematic teaching, experiential education, and teaching that is responsive to student learning styles" (Lake, p. 6).

## Understanding the Technology Standards

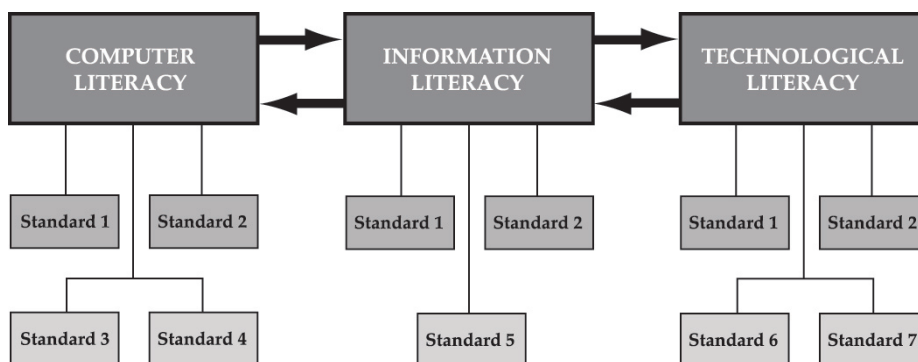
The technology standards address three intersecting literacy areas: computer and multimedia literacy, information literacy and technological literacy, which may be taught simultaneously with other academic content areas. The technology standards are meant to be used in concert with each other.

Standards (1) *Nature of Technology* and (2) *Technology and Society Interaction* are overarching; they are important to each literacy area.

Standards (3) *Technology for Productivity Applications* and (4) *Technology and Communication Applications* serve as the basis for Computer and Multimedia Literacy.

Standard (5) *Technology and Information Literacy* serves as the basis for Information Literacy.

Standards (6) *Design* and (7) *Designed World* serve as the basis for Technological Literacy.



**Computer and Multimedia Literacy** includes the ability to appropriately use hardware, software applications, multimedia tools, and other electronic technology. It harnesses the use of educational technology tools for productivity, communication, research and problem-solving.

**Information Literacy** is the acquisition, interpretation, and dissemination of information. Information literacy focuses on effective methods for locating, evaluating, using, and generating information. Technology-based information literacy skills encompass the utilization of the Internet and other electronic information resources for research and knowledge building.

**Technological Literacy** addresses the abilities needed to participate in a technological world. It is the intersection of mathematics, science, and technology. It specifies unique knowledge, devices, and capabilities used to solve problems. It identifies career connections between technology and the world of work. Technological literacy includes technology education and pre-engineering concepts.

# Cross-Curricular Connections



The first standard, the *Nature of Technology*, helps students understand the core concepts of technology. It addresses the natural and human-made world. There are direct interconnections to Ohio's science academic content standards, particularly the *Physical Sciences* standard and the *Science and Technology* standard.

The second technology standard, *Technology and Society Interaction*, assists students with becoming responsible and ethical users of technology. It defines how technology has impacted society and how societies wants and needs impact technological innovation. Implicit connections occur in Ohio's social studies academic content standards in the *Citizenship Rights and Responsibilities* standard. Connections also exist within Ohio's foreign language academic content standards, in the *Communities* standard.

Skills identified within the third technology standard, *Technology for Productivity Applications*, are fundamental technology skills that can be applied to every content area. Benchmarks and indicators within this standard address the "how to" and focus on use of technology tools, selection of the correct tool for the need, and application of technical "know how" to whatever subject area or topic being studied at the time.



The goals of the fourth technology standard, *Technology and Communication Applications*, are to prepare students to communicate, publish and present the ideas, information and opinions learned in their curricular studies. Electronic communication and distance-learning mechanisms are covered in this standard.



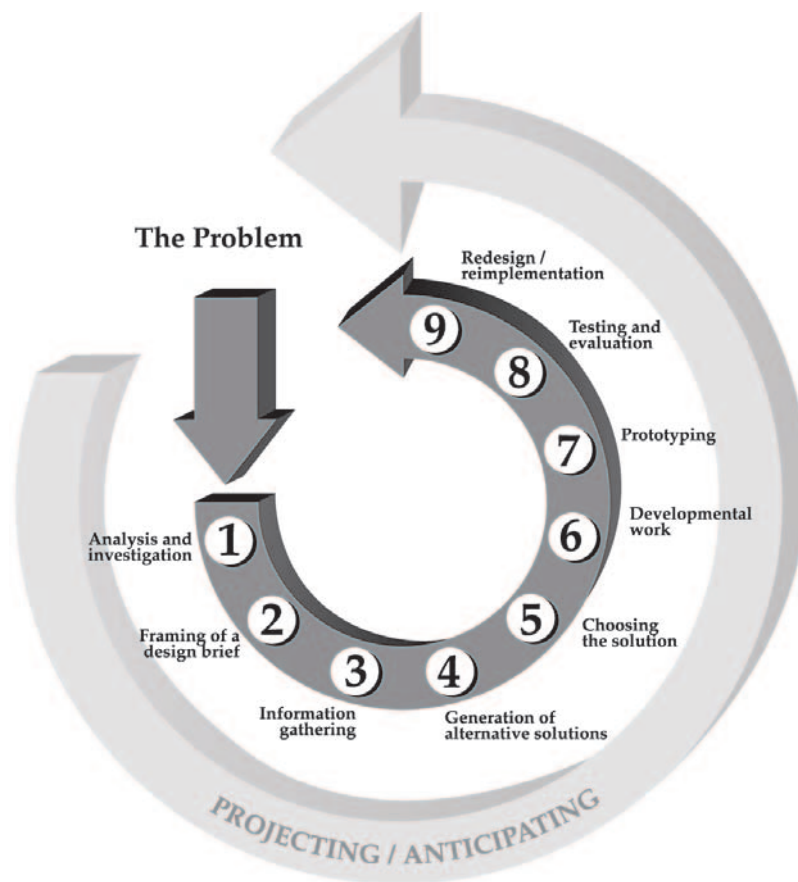
# ACADEMIC CONTENT STANDARDS

The fifth technology standard, *Technology and Information Literacy*, should be integrated into every content area. This standard identifies strategies for conducting research in a technological environment. Effective Internet search strategies and Web site evaluation skills addressed in this standard are transferable to every content area.

The sixth technology standard, *Design Standard*, focuses on the attributes of design and features concepts of engineered design. Students learn about important inventions and technological innovations from a design standpoint. Then, they design solutions and construct devices used to solve technical problems. The importance of evaluating designs for quality is reinforced. This standard has several connections to mathematics and science. In order to design accurate solutions, students must apply concepts learned in the mathematics standards *Measurement, Geometry and Spatial Sense, Patterns, Functions and Algebra*, and *Data Analysis and Probability*. Many connections also exist within the science standard *Science and Technology*.

*Much technological activity is oriented toward designing and creating new products, technological systems and environments. The technological design process involves the application of knowledge to new situations or goals, resulting in the development of new knowledge.*

ITEA 1996, p. 18



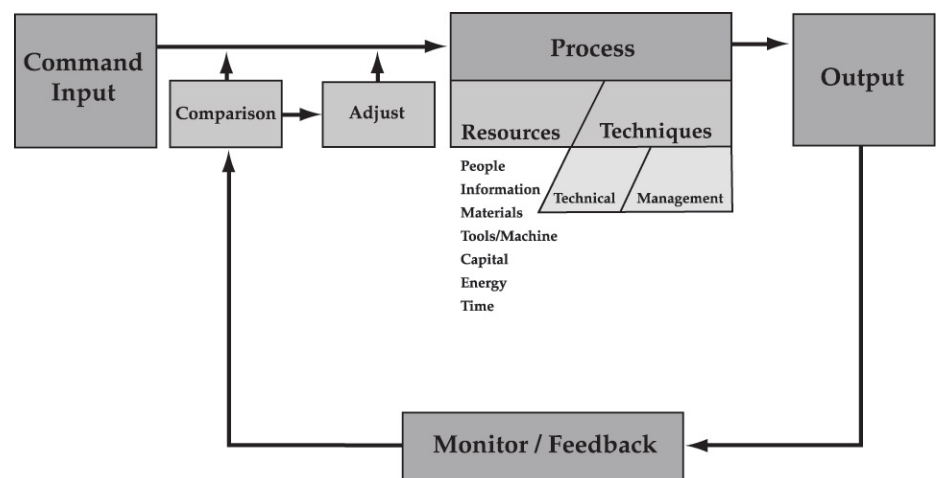
**Design Process**

# ACADEMIC CONTENT STANDARDS

The processes are those actions that people undertake to create, invent, design, transform, produce, control, maintain and use products or systems. The processes include the human activities of designing and developing technological systems; determining and controlling the behavior of technological systems; utilizing technological systems; and assessing the impacts and consequences of technology.

ITEA 1996, p. 16

Technology standard seven, the *Designed World*, addresses real-world applications and supports career connections. Students explore the seven technological systems; medical, agricultural and biotechnologies, energy and power, information and communication, transportation, manufacturing and construction technologies. They learn how each system works, how the system contributes to society, what types of changes have taken place over time in the system and basic skills that support career paths within the various systems.



General Technology Systems Model

## Resources:

American Association for the Advancement of Science: Project 2061, *Benchmarks for Science Literacy*. New York: Oxford University Press, 1993, p. 320.

International Society for Technology in Education. *National Educational Technology Standards: Connecting Curriculum and Technology*. Washington, D.C.: International Society for Technology in Education, 2000.

International Technology Education Association. *Technology for All Americans: A Rationale and Structure for the Study of Technology*. Reston, Virginia: International Technology Education Association, 1996.

Lake, Kathy. *Integrated Curriculum*. Portland, Oregon: Northwest Regional Education Laboratory, 1994, p. 6.

National Research Council, *National Science Education Standards*. Washington, D.C.: National Academy Press, 1996, p. 10.

# Making Real-World Technology Connections

As Ohio's technology academic content standards publication goes to press, staff of the NASA Mars Exploration Rover Mission are directing the robotic testing, analysis, and communications devices on Rover Spirit and the Rover Opportunity as they operate on the surface of the red planet and transmit data and graphic images back to Earth.



The women and men who designed, engineered and built the orbiting craft, descent parachute, inflated-cushion landing sphere, landing craft platform and Rover vehicle that needed robotic sample testing and analysis equipment, communications devices, and related systems and software programs represent technical skills and abilities of the highest order. While all students and citizens may not be required to perform at this level of competence, everyone on Earth is engaged in applications of technology during daily routines and workplace tasks, as well as making decisions about technology-linked developments in their local communities and across the nation. A strength of Ohio's technology academic content standards is in making those real-world connections for students.



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As technology products and processes become more complex, it is important to have specially designed environments and personal protection for the technicians.

*The long-term goal of education is not only to help children develop personal integrity and fulfillment but also to enable them to think, reason and make decisions necessary to participate fully as citizens of a democracy.*

*~John Dewey, Democracy and Education*



It is important to make such connections across all levels of the curriculum. For example, an examination of the Ohio standards connection to professional level technology program criterion, the Accreditation Board for Engineering and Technology, ABET Engineering and Technology Standards reveals many of the key points that Ohio students are expected to know and be able to do in their study of technology. The ABET standards require that engineering programs must demonstrate that their graduates have:

- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design and conduct experiments, as well as analyze and interpret data;
- An ability to design a system, component, or process to meet desired needs;
- An ability to function on multi-disciplinary teams;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global and societal context;
- A recognition of the need for, and an ability to engage in, life-long learning;
- A knowledge of contemporary issues;
- An ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

(ABET 2003).

In order for all students to become technologically literate, they must, through practice, be able to acquire, interpret and disseminate information using computer and multimedia technologies and other means; understand and use physical technologies, such as production techniques and the ability to transport people and goods using appropriate energy and power systems; and be aware of the effects of bio-technologies particularly those related to agriculture, medical technology, regulation and safety and waste management on all aspects of their lives.

Appropriate technology matches realistic uses of technology with practical problems. For example, a wind turbine and solar photovoltaic panel being used in a hilly Southeastern Ohio pasture to power the electric



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pump for keeping a cattle watering trough full, results in better care of the animals, saves the farmer time and labor costs, and has the added benefit of keeping the cattle out of a nearby stream, which also solves a problem of stream bank erosion and impaired water quality.

Throughout Ohio's technology academic content standards is a concern for identifying benchmarks and grade-level indicators that will provide authentic learning experiences for students. Making real-world connections is the particular goal of Standard 7, *Designed World*. This standard provides students an understanding of their role in the designed world including its processes, products, standards, services, history, future, impact, issues and career connections. Some of the themes students engage in are understanding technological systems, technical careers, safety, technical communication, engineering practice, system management, use and maintenance of technological systems, technology assessment, emerging technology and design application.

In order for students to become effective users of technology, they must make connections between fields of technology and their curricular studies. These connections encompass computer literacy, information literacy and technological literacy skills. The study of technology allows students to become technologically literate through understanding the nature of technology, practice of appropriate social and ethical behavior related to technology; the effective use of computer and multimedia resources; capability in designing and producing technological products and systems, ability to use technology for research, information acquisition, communication, and to facilitate cognitive skills.

Technology knowledge, ways of thinking and acting and technical capabilities are important tools in preparing students in a global economy for high-skill, high-knowledge jobs in research, information management, engineering, computer programming, quality control, supervision and fabrication and maintenance (National Academy of Engineering 2002). In implementing these standards, it will be important to have supporting authentic, problem-based, creative instructional strategies and performance-based assessments. The real-world emphasis of Ohio's technology academic content standards will create links between each learner's needs, his or her interests and strengths; and between the classroom, technology laboratory and the world of work and community life.



# ACADEMIC CONTENT STANDARDS

## Resources:

Dewey, John. *Democracy and Education: an Introduction to the Philosophy of Education*. New York: Macmillan, 1916.

Engineering Accreditation Commission, *Criteria for Accrediting Engineering Programs. 2004-2005*. Baltimore: Accreditation Board for Engineering and Technology, Inc., 2003.

National Academy of Engineering and National Research Council, *Technically Speaking: Why All Americans Need to Know More About Technology*. Washington, D.C.: National Academy Press, 2002.



# Program Planning

Ohio's technology academic content standards provide clear expectations for all students. They form the foundation for what every student should know and be able to do in technology programs throughout the state. While local programs and curriculum may build beyond those expectations, the benchmarks and grade-level indicators provide clarity for instruction. Identified content and skills should be the focus of teaching and learning at each grade band and level. To effectively implement a standards-based technology program, teachers and curriculum leaders must determine how instructional programs can be organized, implemented and maintained in Ohio's classrooms, schools and districts.



*All technology academic content standards should be part of the district's technology program. A fully-articulated program of technology studies should include each of the three literacy areas addressed in Ohio's technology academic content standards—computer and multimedia literacy, information literacy and technological literacy. Teachers and curriculum leaders will find that not all content in the standards is new and that sections of their current lessons, projects and units fulfill the expectations of the standards.*

Program planning and implementation is a shared responsibility. Teachers, department chairs, technology coordinators, library media specialists, administrators, curriculum leaders, school boards, parents and community members play important roles in making decisions about local technology programs. Knowledge of standards, best practices and sound research should be incorporated into the conversations that go into developing a coherent technology program in which all components—curriculum, instruction and assessment—fit together well.

A fully-articulated technology program will increase the opportunity for students to learn. The technology program may follow the path of other academic disciplines in that elementary school foundation-level technology skills and abilities support the grade-level appropriate curriculum of the academic content area. Then, as students progress through the grade levels from elementary school to middle and high school, their technology expertise is accelerated at the same time as the level of difficulty of academic content increases.

Basic or introductory technology concepts are addressed by benchmarks and indicators in the K-2, 3-5 and 6-8 grade-bands of Ohio's technology academic standards. Concepts may be integrated into discipline-specific



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*Educators involved with the delivery of technology curriculum may include: computer literacy teachers, technology education teachers, library media specialists, computer science teachers, technology integration specialists and classroom teachers.*



*"New technologies offer teachers additional resources to use as they plan to meet a range of levels, learning styles, and the individual needs of students. Computers and other technologies do not replace other tools or activities, but add to the teacher's complement of tools."*

Van Scoter and Boss, 2002.

studies or delivered in a team-teaching environment where the technology teacher and / or library media specialist collaborate with the classroom teacher. This kind of integrated learning makes technology usage purposeful because students learn skills that are directly connected to their studies.

Technology Education courses taught by technology education teachers, marshal concepts from technology, mathematics and science and provide students with the ability to use technology to solve problems. Design solutions may be taught in a team environment, as well. School districts may offer advanced courses in technology education (e.g., Design Technology, International Baccalaureate Program course) and computer science as students progress through the K-12 technology program.

School districts should review the following items as they begin to revise existing technology programs: Ohio's K-12 technology academic content standards, district or building Continuous Improvement Plan (CIP), district-wide technology program of studies (Curriculum Outline), technology courses of study, the district technology plan, No Child Left Behind requirements and other pertinent district needs or goals. Districts should remember that as technology goals are revised, professional development needs may change, thus requiring professional development plans to be revised simultaneously.

## **No Child Left Behind (NCLB)**

No Child Left Behind, Title II, Part D, Subparts 1 and 2, identifies goals that determine how education can be enhanced through technology. These goals address how technology can work well in schools. The primary goal of NCLB is to improve student academic achievement through the use of technology in elementary and secondary schools. Secondary goals include assisting students in becoming technology-literate by the end of the eighth grade and ensuring that all teachers are able to integrate technology into the curriculum in order to improve student achievement (No Child Left Behind: Desktop Reference, U.S. DOE, 85-87).

As school districts begin to comply with the eighth-grade technology literacy component of NCLB, they may need to reorganize course offerings so that foundation-level technology courses and skills are provided before the end of the eighth grade.

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## Early Childhood Technology Experiences

Several strategies for using technology to enrich the educational experiences of early childhood students have been identified by the National Association for the Education of Young Children. These suggestions may assist teachers in providing an atmosphere where technology is routinely integrated:

- Include technology use in day-to-day classroom activities;
- Use technology to extend activities and expand experiences;
- Place computers inside classrooms, not separately in labs;
- Select software that builds upon topics in the curriculum;
- Use technology to connect cross-curricular subject-matter.

(NAEYC 1998).

In addition to computers and discovery-oriented software, the use of cameras, voice and video recorders, talking books, tools for building and creating things, and other educational technologies may help expand children's social, emotional, language and motor development. Opportunities to use technology as a catalyst to interact with classmates, teachers and learning objects may increase a child's ability to understand and construct knowledge (Van Scoter 2001).

The use of computers and technology tools with preschoolers, kindergarteners and primary-grade students should be based on developmental appropriateness. Generally, computer use by children under the age of three is not recommended (Hohmann 1998). The American Academy of Pediatrics recommends that television viewing and video and computer-game playing time be limited to one to two hours per day for very young children (AAP 2000).

## Assistive Technology

Assistive technology devices and services enable students with disabilities to achieve higher expectations, participate in less restrictive environments and gain independence. Assistive technology devices and services are tools that support the student's ability to perform educational tasks more effectively and with more efficiency.

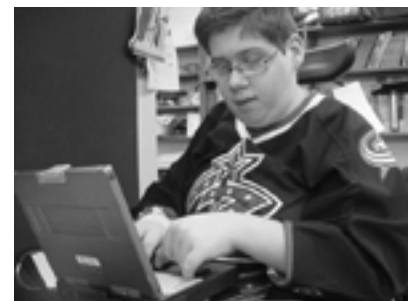
"With appropriately selected and used devices and services, students with disabilities can access the same educational opportunities and meet the same academic standards as their classmates" (NASBE and U.S. DOE 1999).

The Individuals with Disabilities Education Act (IDEA) amendments of 1997 require that the need for assistive technology be considered for



*"Early childhood professionals must apply the principles of developmentally appropriate practice and appropriate curriculum and assessment when choosing technology for use in their classrooms."*

National Association for the Education of Young Children position statement on Technology and Young Children, Ages 3 through 8. (1998).



# ACADEMIC CONTENT STANDARDS

*Assistive technology is "any item, piece of equipment or product system, whether acquired commercially or off the shelf, modified or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability."*

IDEA - P.L. 105--17, Part A - General Provisions, Section 602, Definitions.

ORCLISH

[www.orclish.org](http://www.orclish.org)

*Section 508(a)(2)(A) of the Workforce Investment Act of 1998 includes the Rehabilitation Act Amendments that require the federal government's Architectural and Transportation Barriers Compliance Board to publish standards establishing a definition of electronic and information technology and the technical and functional performance criteria necessary for accessibility of such technology.*

every child receiving special education services. For example, a student with visual impairments uses a closed circuit TV to magnify text. A student with hearing impairments uses an amplification system to receive teacher instruction. A student who is unable to speak points to pictures on a communication board to interact with classmates. A computer can be used to complete written work for a student who is having difficulties with reading and writing. A student with motor difficulties uses adapted sporting equipment to participate in the physical education curriculum. Through the use of assistive technology, students with disabilities are given an opportunity to access and progress in the general curriculum.

Additional information regarding assistive technologies, access to devices and professional development for teachers may be obtained by contacting the Ohio Department of Education's Office for Exceptional Children and Ohio Resource Center for Low Incidence and Severely Handicapped (ORCLISH).

DisabilityInfo.gov is a comprehensive online Web site designed to provide people with disabilities the information they need. The site provides access to disability-related information and programs made available by the government on numerous subjects, including civil rights, education, employment, housing, health, income support, technology, transportation and community life. (disabilityinfo.gov)

## Accessible Technology

Technology is accessible when it is easily used by people with disabilities and is designed to be available to anyone, no matter what assistive technology he/she might use or how he/she accesses the information (SREB, 2003). The Southern Regional Education Board (SREB) published a brochure *Accessible Information Technology Resources: A Quick Reference Guide for Educators* that identifies several organizations, agencies and Web links that provide information on assistive and accessible technologies.

The World Wide Web Consortium (W3C) through its Web Accessibility Initiative (WAI) is developing technologies, guidelines and tools in order to "bring the Web to its full potential" (World Wide Web Consortium 2003). In addition to the tools that support accessible Web design used by designers of Web content, educators and other Web consumers can use tools to evaluate Web accessibility. Web site validators allow Web users to verify accessibility or inaccessibility of Web sites. Bobby™ (www.cast.org/bobby) a common Web validation tool may be used to test a Web site's accessibility compliance with the World Wide Web Consortium accessibility guidelines and the 508 guidelines (Lazzaro).



# ACADEMIC CONTENT STANDARDS

## Resources:

American Academy of Pediatrics, Committee on Public Education. Children, Adolescents, and Television. *Pediatrics*. Vol.107, Elk Grove Village, Illinois: American Academy of Pediatrics. 2001, pp. 423-426.

Hohmann, C. (1998). *Evaluating and Selecting Software for Children*. Child Care Information Exchange, 123, 60-62.

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# Planning for Instruction



The Committee on Education and Human Resources (CEHR) of the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) stated:

*"Citizens of the future must be equipped to make informed decisions in this age of rapidly developing knowledge, changing technology, sophisticated information, and communication systems. Accordingly, America's performance in science, mathematics, engineering and technology must be second to none in the classroom and the workplace."*

(FCCSET, CEHR 1993).

Ohio's technology academic content standards were developed to ensure that all students would become technologically literate citizens to meet the needs of the future. It is through the understanding and effective use of technology that students will be better equipped for everyday life and the workplace.



Ohio's academic content standards provide the foundation for planning integrated instruction and assessment in the classroom. Although the benchmarks and indicators are presented as separate statements of knowledge, the intent is to promote integrated instruction. The indicators suggest specific content for lessons that will integrate content and concepts across the standards and disciplines to build mastery towards the benchmarks. This integration is a vital component of standards-based education.

Standards-based education is a process for planning, delivering, monitoring and improving academic programs in which clearly defined academic content standards provide the basis for content in instruction and assessment. In standards-based education, the standards help ensure that students learn what is important, rather than allowing textbooks to dictate classroom practice. Student learning is the focus of standards-based education. Standards-based education aims for a rigorous and in-depth student understanding that goes beyond traditional textbook-based or lesson-based instruction.

Although standards define individual skills, standards-based education does not promote a skill-by-skill methodology. Multiple standards can and should be integrated in instructional activities. From the benchmarks, you must identify and document the enduring concepts or "big ideas" that students should learn so they will ultimately understand



# ACADEMIC CONTENT STANDARDS

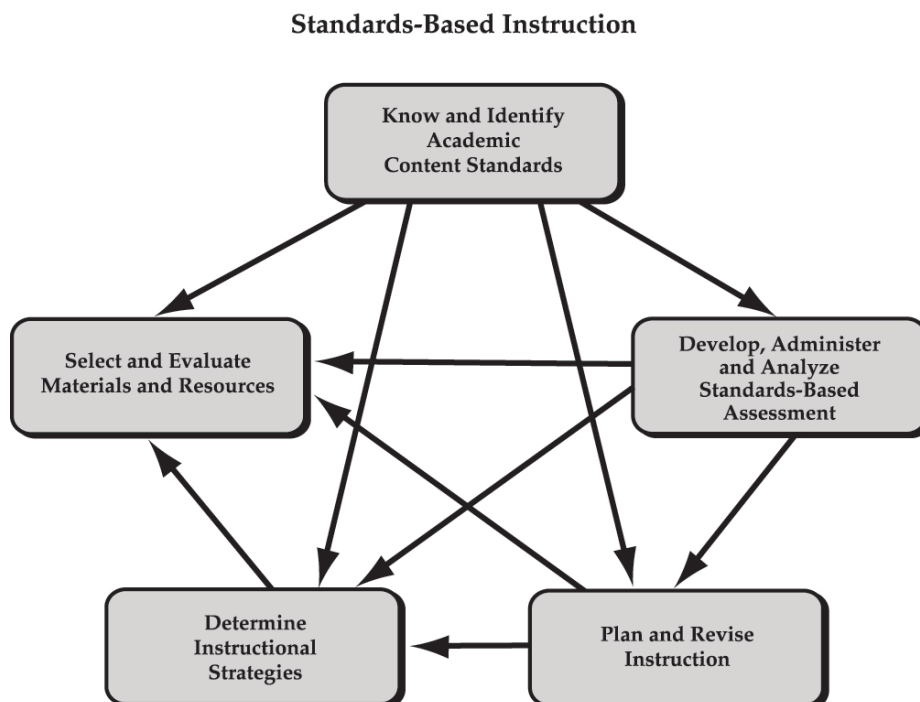
the standards and benchmarks in technology. "The term enduring concept refers to the big ideas, the important understandings, that we want students to 'get inside of' and retain after they've forgotten many of the details (Wiggins and McTighe, p. 10)."

In a standards-based classroom, teachers start with the state standards as the basis for classroom instructional planning, rather than starting with a textbook or other classroom materials. Teachers select a unit of instruction that meets the standards, benchmarks and indicators and use the standards to determine how the unit shall be designed, assessed, delivered and evaluated. The graphic in Figure One shows how standards form the basis for all planning, instruction and assessment. Note how the arrows extend from the academic content standards. Also note that resources, which may have previously been the basis for instructional planning, are selected only after decisions have been made about content, assessment and instruction; note that the arrows in the graphic lead to resources—no decisions are driven by resources.

*"Start with the end (the goals or standards) then consider the evidences of learning (assessments) before planning the teaching and learning experiences."*

Wiggins and McTighe,  
1998

Figure One



# ACADEMIC CONTENT STANDARDS



The standards define the outcomes, or expectations, of what students need to know and be able to do. These outcomes include big ideas that students will acquire by the end of the unit and more discrete ideas that might be developed at the lesson or activity level within the unit.

These defined outcomes serve as the basis for assessment planning within instruction. The outcomes can help teachers plan a pre-assessment that can be administered and used to determine the starting points and focus for instruction. A summative or final assessment should be planned to address both big and discrete ideas, thus assessing student performance and the success of instruction, and identifying any needed re-teaching. In addition, the outcomes help focus ongoing instructional assessment throughout the unit with teachers monitoring students' progress. At times, students may also use self-assessment strategies to monitor their own progress. These assessments provide teachers with the information that they need to plan and deliver focused, effective instruction for each student in their classrooms.



## Resources:

Federal Coordinating Council for Science, Engineering, and Technology, Committee on Education and Human Resources. *Pathways to Excellence, A Federal Strategy for Science, Mathematics, Engineering, and Technology Education*. Washington, D.C.: 1993.

Wiggins, Grant and Jay McTighe. *Understanding by Design*. Alexandria, Virginia: Association for Supervision and Curriculum Development, 1998.



# Vignettes

## Vignette 1: Cast Your Vote

The following vignette includes concepts from social studies, English, mathematics and technology.

The social studies class is learning about presidential elections. They are studying campaigns, voting and elections. This particular unit requires students to:

1. Determine which candidate they support;
2. Write an informative paper about the candidate;
3. Deliver a persuasive speech about the candidate;
4. Vote in a mock election;
5. Analyze vote results.

Before the students can (*1. determine which candidate they support*), they must find information about all of the candidates. Students begin by identifying what they need to learn about a candidate that will help them decide whether they support the candidate or not. They determine their need to know the candidate's party affiliation, experience and stance on issues.

Students start their research by visiting the library and looking for books, magazines and newspaper articles about the candidates. They use the Internet and electronic resources. They quickly discover that there are a variety of Web pages about each candidate, so they need to evaluate the Web sites. They determine the authority of the Web site. They want to find out who the author or owner of the site is. They want to determine if the candidate sponsors a Web site to provide information to the public. Then they identify the bias of the Web site. If the site is sponsored by a supporter of the candidate, it may overplay the contributions of the candidate. If the site is sponsored by an opponent of the candidate, it may intentionally misrepresent the candidate. The students want to base their candidate selection on accurate information.

Next, the students organize their information by using concept maps or graphic organizers. This helps them to categorize their research on each candidate based on the questions that they wanted to answer (candidate's party affiliation, experience and stance on issues).

Students review their research and watch campaign commercials. They analyze each campaign commercial and try to identify the main message in the commercial. They begin by determining whether it is a positive or negative ad. They try to determine who sponsored the ad. They check

*Social Studies: Government Standard and Citizenship Rights and Responsibilities Standard*

*Technology: Technology and Information Literacy Standard*

*Technology: Technology and Productivity Applications Tools Standard.*

# ACADEMIC CONTENT STANDARDS

*Technology: Technology Information Literacy Standard and Technology and Communication Applications Standard. Connections also present in the Library Guidelines: Media Literacy Guideline.*

*English Language Arts: Writing Processes Standard, Writing Applications Standard, Writing Conventions Standard.*

*Technology: Technology and Communication Applications Standard.*

*English Language Arts: Communication- Oral and Visual Standard.*

*Mathematics: Data Analysis and Probability Standard.*

whether there are any references to news articles or a candidate's voting record. If so, they review the references to see if they support the message in the ad or not. They also assess the ad to determine if the production techniques influence the message. They ask themselves if the same speech were delivered in a different setting, would the meaning change? Was the setting or backdrop manipulated through technology to produce a different effect on the viewer?

After carefully analyzing all of their research, students select a candidate to support. The students are now ready to begin writing their (2. *informative papers*) about the candidate that they selected. They use desktop publishing software to create papers that include photos, tables and bibliographic citations.

Next, the students are ready to develop their (3. *persuasive speeches*). They think about the purpose of their speech first. The goal is to use their research to write a speech that will persuade their classmates to vote for the candidate that they selected. The students use presentation software to add impact to their speeches. They include photos, video, sound charts and other technical effects that may enhance their speeches.

The students decide to take a "straw poll" vote before they present their persuasive speeches. They create a bar graph of the results, comparing the straw poll results that took place before the persuasive speeches to the final vote results. This enables them to see if any of the speeches effectively persuaded votes to change.

The students deliver the (3. *persuasive speeches*) supplemented by electronic presentation materials. They ask each other questions and debate issues. Then they participate in the (4. *mock election*). They record, chart and tally the votes.

The concluding activity is to (5. *analyze the vote results*). The students create spreadsheets, bar graphs and pie charts of the results of both the straw poll and the final election. They determine the percentage of total votes that were changed after the straw poll. They calculate the percentage of votes gained and lost by each candidate between the straw poll and the final vote.

## Real-World Connection

Technology was integrated throughout this vignette. The student learned about campaigns and elections, writing and speaking, data analysis and technology skills.

Even if the student does not follow a career path involving politics or technology, the student has developed technology knowledge, skills and abilities which will help him/her be an informed consumer of civic information.

## Vignette 2: Curriculum Integration Opportunities in a Technology Systems Experience

Students are engaged in a Construction Systems course that provides them with a working understanding of the key elements used in the planning, designing and constructing of an on-site structure. It is recognized that the construction industry is a major industry in contemporary society and has a dramatic influence on the environment in which people live. In our technological society, it is necessary for all people to obtain a fundamental understanding of construction practices, including the procedures for servicing and maintaining structures.

Overall, the Construction Systems course experience enables students to:

- Relate construction technology to the broader context of industry and technology;
- Appreciate, understand, and perform selected production and servicing practices;
- Appreciate and have an understanding about construction technology tools and materials;
- Perform selected management practices in planning, directing and controlling;
- Describe the interrelationships within and among construction, the environment, individuals, and society;
- Develop an awareness of careers in construction technology and related fields;
- Develop an awareness of the significance of construction technology in the past, present and future;
- Develop responsible and safe work attitudes and the ability to function as a member of a group;
- Develop consumer and citizenship skills regarding the design and maintenance of buildings; and knowledge of development issues.

The goal is to have students learn these concepts through hands-on activities, using contemporary construction tools, management techniques and materials. Student experiences are designed to include exposure to various types of structures, including residential, commercial and industrial buildings, bridges and public utilities. The emphasis is on student understanding of all the concepts associated with each of the major content elements, as well as the interrelationships of management and production functions in the construction technology system. In order for students to be successful, and also to get the most

# ACADEMIC CONTENT STANDARDS

out of the experience, coordination with other subject teachers will provide opportunities for the application of academic content to the solution of construction-related problems. The availability of school space and resources might limit the size and complexity of student projects and activities. Construction-related assignments may include development of models, materials testing on component parts, building wall section modules, or construction a full-size or scale building. One unique opportunity available in many communities might be working as a partner with a local Habitat for Humanity project team. Working in the community on a real project with the project's homeowner / family should have added benefits in fostering a greater sense of responsibility and attention to detail in their work.



Student research, explorations and activities will cover the life cycle of a structure. Major topics include the research and development process, preparing the site, building the structure, enclosing the structure, installing utility systems, finishing the structure, servicing structure systems and salvaging constructed projects.

Career education links include identifying and adopting the roles representing the construction trades and engineering / technical professionals, and related legal, planning and technical sales fields in class projects. Opportunities to talk with persons working in the construction technology systems area, and participating in experiences to test-drive their interests in technical fields and related professional level careers would be beneficial to student learning.

Academic content links include English language arts applications supporting student research, written communications, technical communication and the design and presentation of reports. Social studies engages students in issues of procedures and reasons for zoning, building codes, construction safety regulations, construction site environmental protection concerns, and issues of community and economic sustainability.

Mathematics provides a background for understanding concepts used in the surveying of a building site, building foundation layout, computing strength of structural components and computing structure surface areas for determining quantities of various building materials required. The concepts include:

- Understanding the specifications of building systems such as computing airflow volumes needed in determining appropriate heating, ventilation and air conditioning system equipment selection;
- Developing the ability to figure and project the costs of alternative building designs and energy efficiency materials and practices.

# ACADEMIC CONTENT STANDARDS

Science applications will focus on understanding the physics of structural design and the functioning of electrical and mechanical systems such as:

- Determining the performance qualities and effectiveness of heat and sound insulating materials;
- Understanding the environmental issues and environmental health science concerning indoor air quality;
- Recognizing the basics in the chemistry of paints, adhesives, plastics and building finishing materials;
- Being able to make sound judgments regarding alternative fuels and energy efficiency practices.

Several students in the class are also participating in a weekend design workshop series for high school students sponsored by the regional chapter of the American Institutes of Architects. These students are invited to share with the class what they have learned about design, site planning, model building, concept presentations, and featured architectural projects in the area.

## Vignette 3: Window into a Middle School Technology Program

The middle school technological studies program began with the teacher meeting with a class of students. They were analyzing a recent project: mass-production of a toy. Students had researched, designed, manufactured and distributed the item to their customers. Discussions later centered on an upcoming technology festival exhibit and an assignment requiring a written report on technology systems careers.

In the course of the project, the students entered the technology laboratory area, which is designed for multiple activities. Students worked at different stations, studying how a computer can simulate manufacturing processes, how a video camera is used to produce the school's morning announcements and how hydroponics is used to raise food. One group arranged posters on the wall to create a time line illustrating inventions and the history of technology. Another team of students used a computer's desktop program to prepare a research report on the impact of technology. In another corner students recorded results as their balsa wood model bridges were tested with heavy weights.

Later, the teacher explained that the class included students with a full range of abilities. All benefited from the study of technology. The teacher explained that the technology course included opportunities for practical application of mathematics, science, social studies and English.



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It was noted that all students would need to understand technology, which includes developing knowledge, ways of thinking and acting, and capabilities. The teacher expressed the belief that theory and practice must be blended to provide an opportunity for students to learn by doing.

A key component of this vignette, which is necessary for all rich technology programs, is integration. The integration of technology into all content areas enhances learning and supports effective instruction. As teachers develop their lessons they should also take into consideration the following points:

1. *Engage students in active instead of passive learning.*

For education to be of value, learning must be retained. Research has shown that learners will not retain things that they mimic, nor can they use things memorized to help them understand something new.

2. *Focus on how different learners progress in their understanding of ideas.*

Understanding the progression of how learners develop ideas to increasing levels of sophistication should be part of the teacher's professional knowledge. For example, differences in learning styles are more readily visible at the computer, where children have the freedom to follow diverse paths towards a goal (Wright 1994). Also, gender differences emerge when children engage in programming. In one study, a post-test-only assessment seemed to indicate that boys performed better. However, assessment of the children's interactions revealed that the boys took greater risks and thereby reached the goal. In comparison, girls were more keen on accuracy; they meticulously planned and reflected on every step (Yelland 1994).

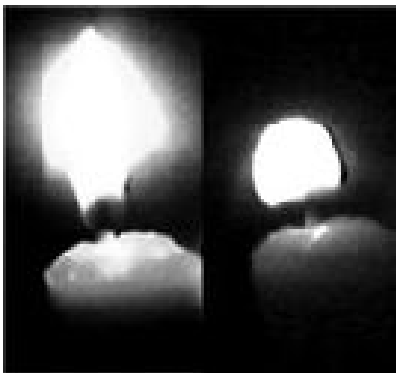
3. *Provide structured review and reinforcement to maintain a high level of retention.*

Constant reinforcement of ideas and concepts can help to ensure long-term learning of skills, processes and strategies. In addition, the integration of content previously learned and the provision of contexts for learning can ensure that students have a scheme for new learning.

Lessons that include performance-based tasks or projects allow for a greater opportunity to evaluate student understanding. Formative or regular ongoing assessments are used to gather information to improve teaching and learning. Summative assessments allow for evaluation of what students know and are able to do at the completion of their tasks or projects.



Students prepare the combustion chamber for a microgravity experiment. A wireless video camera mounted in the tower records the shape of the candle flame during the drop.





The following vignette shows the value of a performance-based project.

## Vignette 4: Developing an Electrical System Model

This semester, students in Mr. T's Tech Prep automotive class have been studying the electrical system of the automobile. He has been able to describe and explain to his class the various components of the system in such a manner that all students passed their written test in which they were to describe the purpose of each component of the system. Phase Two of the unit required students to design and create a model of the electrical system of an automobile.

On the first day of Phase Two, students were divided into four teams of four. Mr. T began this portion of the unit with a discussion of what his expectations were for the project. He listed for his students on a slide-show the expectations for the project:

1. Design and create a model of the electrical system of the front end of an automobile;
2. The design must include the following components: headlights, turn signals, emergency lights, a horn and a power source. Students could add additional components for extra credit;
3. Research new and upcoming technology geared towards the electrical systems of automobiles;
4. Present their project (design process, completed design and research findings) to a committee of local community automotive experts. Each team would be expected to answer any questions asked of them by the committee.

After explaining his expectations for the students, Mr. T and the teams spent the remainder of their lab time discussing and creating the criteria or rubric that would be used by the committee of automotive experts to evaluate each project.

Day Two began with a pre-assessment. The students would need to correctly design electrical circuits to be able to connect all their components without burning them up. This would require an understanding of Ohm's Law (Voltage = Current X Resistance,  $V = IR$ ) and an understanding of how to work with two types of electrical circuits, series and parallel. As a pre-assessment, Mr. T gave a quiz that required the use of Ohm's Law. After grading the quizzes, Mr. T found that some students did not understand how parallel circuits worked, and so a review lesson was needed.

### Standard 7 Designed World

#### Grade 11

#### Benchmark A

*Classify, demonstrate, examine, and appraise energy and power technologies.*

#### Indicator 3

*Use series circuit and a parallel circuit to modify the voltage and current available from a group of batteries.*

# ACADEMIC CONTENT STANDARDS



Students were divided into groups. Each group included a student that led the group in reviewing how parallel circuits worked. The students used materials provided by Mr. T. As the students reviewed the concepts, Mr. T walked around the room observing and providing tips when necessary. Upon completion of the review, Mr. T felt satisfied that all his students understood the content, so the students were allowed to begin their designs.

As a way to monitor their work, students were required to create a spreadsheet listing all the components they were going to use and the tolerances connected to each component. Also on this spreadsheet, teams were expected to display all calculations needed for their design. Upon completion, the teams began to create their "electrical systems." Teams were given a week for the designing, creating and testing of their projects. Throughout the process, Mr. T took on the role of an advisor to the teams. He did not directly provide answers to their questions, but provided guidance so that team members were able to determine their own answers.

After a week, Mr. T evaluated the progress of each team and found that the teams were ready to proceed to the next phase of their projects. Each team was split into two sub-teams. Two students worked on the slide show presentation that would explain their design process and design, and the remaining two students researched new and upcoming technology in the field of automotives.

## **Standard 5 Technology and Information Literacy**

### **Grade 11**

#### **Benchmark D**

*Evaluate choices of electronic resources and determine their strengths and limitations.*

#### **Indicator 1**

*Modify a search through the use of different key words and other techniques specific to an electronic resource.*

#### **Indicator 3**

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

The researchers of each team were required to prepare a one-page report of their findings. Students were permitted to search on the Internet for information but were required to use two technical magazines from a library for their research. As a former professional from the field of automotives, Mr. T understood the value of teamwork and the importance of communication within a team. Therefore, as part of the project, team members were required to present their project to a committee of experts.

Mr. T also required that the two sub-teams of each team switch roles when they were to present their project. For example, on Team A, Lisha and Dominic were responsible to create the slide show showing their design process and design while Brandon and Jamir were responsible for the research. Therefore, when Team A presented, Lisha and Dominic talked about the research, and Brandon and Jamir presented the slide show. The students did not prefer switching roles to present but were able to learn more as a result.

After several days of sharing their work and practicing speeches, the teams presented to the committee of automotive experts. The students were nervous as they shared their projects but felt it was a valuable lesson. Having to share their experiences and answer questions permitted the team members to see how much they had each learned.

# ACADEMIC CONTENT STANDARDS

Meeting automotive experts from their community provided another benefit—connections to possible future employers.

Mr. T's unit incorporated standards, benchmarks and indicators in a way that addressed various learning styles. The strong connections made to specific indicators and benchmarks helped move his students to mastery. By involving the local community in the work, he opened important lines of communications with major stakeholders.

Teachers and curriculum leaders must consider how each lesson fits into the progression of the year. They must look at the skills being developed and how each lesson influences what can be explored in the future. Additionally, they must plan and develop assessments that provide valuable information about student understandings and drive lesson design. These components of standards-based education will provide Ohio teachers with a clear instructional plan to help all students meet the demands of the 21st century.

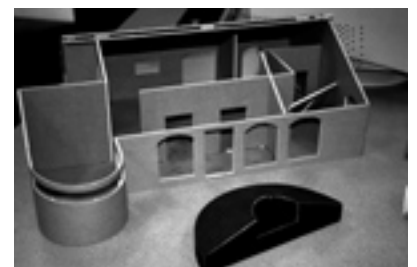
## Vignette 5: A Student's Perspective

During my sophomore year of high school, I signed up for the course, Introduction to Technology. I didn't know much about computers and technology, nor did I know what the class was about. We started off with the basics. We studied programs that we were going to be using throughout the year, and so it didn't matter how much computer experience I had in the past. Everyone started off at the same level.

Throughout first semester, we went over how to draw 3D views, designing on the computer, and occupations that deal with technology, but our midterm project became one of the most interesting assignments I have ever been given. My peers and I were asked to design and build a toy. Our requirement was to include three mechanisms within the toy and write a report. We studied mechanisms and how they were used in our everyday lives. I worked a few months on this project, and at the end of the first semester, I realized I did not know how precise a mechanism had to be in order to function.

During the second semester we learned how to make 3D drawings on the computer, studied the importance of parts and simple objects, like a paper plane, and our final project was to create a robotic arm and create a Web site with our report. I was to use hydraulics or pneumatics to have the arm pick up and carry an Easter egg filled with clay. It was extremely challenging, but then I figured out different techniques to get the arm to work.

Since then, I became intrigued on how things worked or how things moved. When I see a machine, a toy or anything that moves without human hands, instead of just watching the object, I study it and try to



# ACADEMIC CONTENT STANDARDS

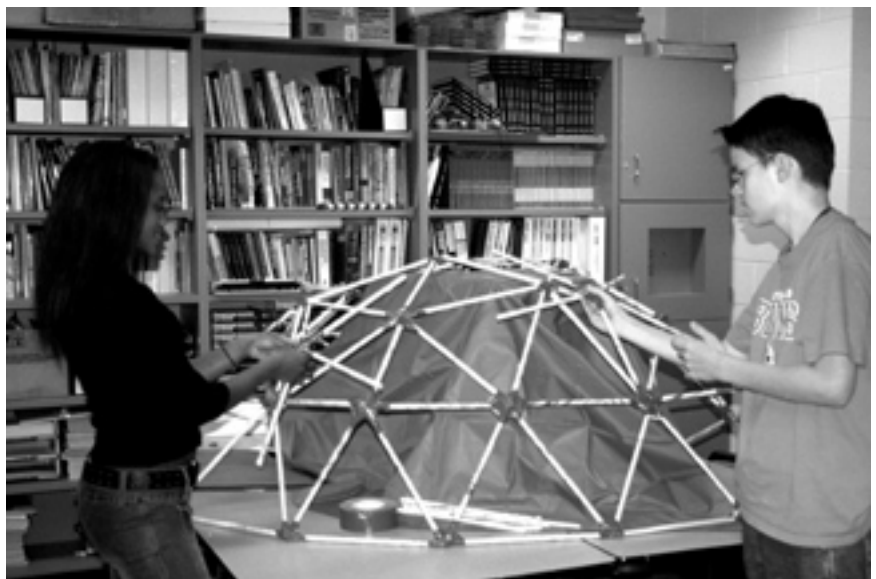
figure out what makes it perform. I went from not knowing anything about the technology world, to being fascinated by the fact it was all around me. The class changed the way I think and how I look at technology.

Female Student, Dublin Scioto High School

## Resources:

Wright, J.L. Listen to the Children: Observing Young Children's Discoveries with the Microcomputer. In *Young children: Active learners in a technological age*, eds. J.L. Wright and D. D. Shade. Washington, D.C.: National Association for the Education of Young Children, 1994, pp. 3-17.

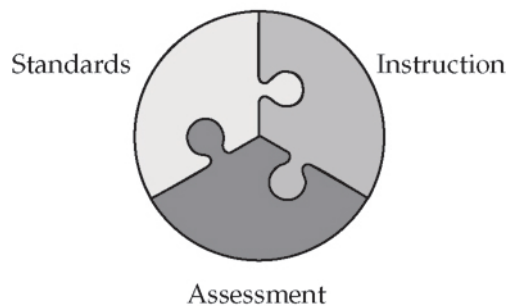
Yelland, N. The Strategies and Interactions of Young Children in Logo Tasks. *Journal of Computer Assisted Learning*, Vol. 10, 1994, pp. 33-49.



# The Role of Assessment

A strong, effective, aligned educational system has three parts. Standards; curriculum and instruction; and assessment aligned with the standards; combined to create an integrated system.

The Three Parts of an Aligned Educational System



*An effective comprehensive system for assessing students' performance and progress towards the academic content standards is comprised of both state and local or classroom-level assessments.*

Ohio has adopted clear and rigorous academic content standards for its students. Educators and members of the public need to know if students meet these standards. Assessment is a means of collecting evidence about what students know and are able to do. The process of assessment provides students with opportunities to demonstrate their understandings related to content standards. A comprehensive and thoughtful assessment system also provides educators with needed information for improving instructional planning and decision-making.

Ohio's comprehensive assessment system includes several types of assessment:

- Classroom assessments;
- Diagnostic assessments;
- Achievement tests;
- National and international assessments.

Each type of assessment provides invaluable information to Ohio's educators, parents, students and communities. While each approach to assessment supports the others, each also serves its own unique purpose.



# ACADEMIC CONTENT STANDARDS

Ohio's Comprehensive Assessment System		
Assessment Types	Basis for Content	Purpose
Classroom Assessments	Local Courses of Study and Standards	<ul style="list-style-type: none"> <li>• Measure process as well as product of student understanding and knowledge.</li> <li>• Inform teachers and students about progress.</li> <li>• Provide information for instructional planning.</li> </ul>
Diagnostic Assessments	Ohio's Academic Content Standards	<ul style="list-style-type: none"> <li>• Monitor student progress.</li> <li>• Make instructional decisions (e.g., intervention, enrichment).</li> <li>• Provide information to students, parents and teachers.</li> </ul>
Achievement Tests	Ohio's Academic Content Standards	<ul style="list-style-type: none"> <li>• Measure student achievement.</li> <li>• Demonstrate evidence of continuous improvement at the state and local level.</li> <li>• Provide data for Ohio's accountability system.</li> </ul>
National and International Assessments	National and International Standards	<ul style="list-style-type: none"> <li>• Compare Ohio achievement against that of other states and nations.</li> </ul>



# ACADEMIC CONTENT STANDARDS

## Classroom Assessment

In the classroom, effective educators use various forms of assessments to plan and provide effective, targeted instruction in the academic content standards and to help students identify their areas of strength and weakness. As educators develop their classroom assessments, they should realize that the role of assessment in the integrated technology classroom should include three main areas:

1. Assessment of programs;
2. Assessment of the use of technology;
3. Assessment of student achievement.

(National Research Council 2001).

## Assessment of programs

Technology in the classroom should be a seamless component of the curriculum. Whether technology is the focus (in a technology course whose focus is technology education) or technology that is to be integrated into another content with the intent to enhance the opportunity to meet teaching and learning goals, educators must assess their purpose for the technology. This requires educators to evaluate their programs to ensure objectives are well planned and aligned to the academic content standards.

## Assessment of the use of technology

The appropriate use of technology in a classroom allows students the opportunity to demonstrate what they know and are able to do. Assessing how students use technology to demonstrate their understanding of the technology is beneficial to both students and educators. The effective use of technology by students can be evaluated by using authentic or alternative assessments such as a performance-based assessment. Performance-based assessments (e.g., problem-based learning, design problems, design teams) involve requiring students to perform a task and observing and rating the process against set criteria.

This criterion is often developed within a rubric. The intent of the rubric should be to detect strengths and weaknesses and identify areas of needed improvement. Students help develop the rubric which can be used at any time during the activity. It can be used by students as a self-assessment as they work on the activity and/or as a final assessment of their work. Their involvement with the rubric clarifies and enhances the learning process because students understand the expectations of the activity or task.



*"It is essential that a technology plan identifies and implements quantifiable assessments, so that the plan results can be measured and activities can be adjusted in accordance with those results."*

A Proven Method of  
Assessing Technology  
Integration For Teachers  
and Students, p. 7

*"If students are to participate effectively in the [assessment] process, they need to be **clear about the target and the criteria** for good work, to assess their own efforts in light of the criteria, and to **share responsibility in taking action** in light of the feedback."*

National Research Council,  
p. 9

# ACADEMIC CONTENT STANDARDS



There are basically two different types of rubric formats. One is a holistic rubric that describes the qualities of performance for each performance level (for example, each score point from 1 to 5). Another is an analytic rubric that assigns scores to different components of a task. Regardless of the type of rubric an educator develops, there are a number of steps that should be followed during development:

1. Use the academic content standards to ensure that the assessment is aligned with the standards. Determine the essential learning objectives that need to be measured by the rubric;
2. Describe what evidence students will need to produce to show that they have mastered the learning objectives described in the rubric;
3. Make sure that the learning objectives and performance expectations are clearly communicated for students on the assessment task;
4. Determine the number of levels in the rubric appropriate to the task or activity. In some cases, a three-point rubric may be sufficient. A four-point rubric is more effective at forcing distinctions between responses;
5. Describe the performance expected at each score point in each characteristic;
6. Score some student responses with the rubric to ensure that it is fair, easy to use and effective at making the appropriate distinctions between levels of performance. Revise as needed;
7. Explain to students how they will be scored on the task. (Share rubric content and process with students before activity begins);
8. Compare student work against the rubric.



## Assessment of student achievement

The assessment of student achievement often occurs concurrently while assessing the use of technology. The question that often arises is, "Does the use of technology increase student achievement?" Research studies have shown that it is difficult to identify a direct correlation between the use of technology in the classroom and student achievement. However, the studies do indicate that students in technology-rich environments showed increased achievement in preschool through higher education for both regular and special needs children.

(Schacter 1999)

Therefore, in designing lessons, educators must evaluate the intent or purpose for the assessment in their lessons. Does the assessment measure what it was designed to measure? Does it measure student



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understanding? Are students given the opportunity to show what they know and are able to do? Grant Wiggins (1998) notes that educators should, "Use simulations or real applications that require students to use knowledge with an overarching purpose, audience, and setting (context) in mind." The goal is to provide authentic assignments that require students to apply the skills that they have mastered. These authentic assignments will create within the classroom opportunities to better measure student understanding.



When assessing individual achievement of students, the use of both formative and summative assessments is encouraged. Formative assessments (i.e., assessments given during the activity to monitor student progress) permit educators to determine areas that need strengthened in their students so that the teacher can revise instruction to meet the needs of students. Summative assessments, which occur at the completion of an assignment, allow students to demonstrate what they have learned and to determine if learning objectives have been met. Both types of assessments together give a clearer picture of what students know and are able to do in meeting the academic content standards.

## Diagnostic Assessments

Ohio's assessment system enhances the work teachers do in classrooms by providing for annually administered diagnostic assessments. These assessments are drawn from the expectations found in Ohio's academic content standards grade-level indicators.



Depending on the content area involved, diagnostic assessments are administered at various grade levels from kindergarten through eighth grade. They are designed to provide common instruments that districts may use to obtain a second perspective on the strengths and weaknesses of individual students. They provide teachers with important information for instructional planning. These assessments also identify students who need additional help meeting the content standards and preparing for the achievement tests.

## Achievement Tests

Achievement tests, including the Ohio Graduation Tests, are a third component of Ohio's comprehensive assessment system. They provide periodic checkpoints of student progress in meeting the benchmarks established by the state's content standards.

The results obtained from the achievement tests provide a broad measure of student achievement. The results provide guidance for districts in making program decisions. They may be used to make decisions related to the allocation of resources at the state and local levels.

*Ohio's assessment system includes diagnostic and achievement assessments. These are being created with substantial input from Ohio's classroom teachers, parents, administrators, higher education faculty and business/community representatives.*

## **National and International Assessments**

Ohio's assessment system is complemented through the state's participation in national and international assessment processes, such as the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS). Participation in these assessments enables Ohio to compare the achievement of its students with that of students in other states and nations. In this way, Ohio ensures that its standards are sufficiently rigorous and world class.

Ohio has taken great strides to ensure alignment with the Elementary and Secondary Education Act (ESEA), known as No Child Left Behind (NCLB). NCLB requires that all students become technology literate by the end of the eighth grade. This means that basic or introductory technology concepts should be achieved before the end of eighth grade. Educators that align their curriculum to the technology academic content standards will meet this mandate.

## **The Best Preparation for All Types of Assessment**

In Ohio's aligned educational system, educators collaborate to design, refine and enact instructional plans and classroom assessment strategies based upon the benchmarks and grade-level indicators that are contained as part of the academic content standards. These educators know:

- That they will not have to set aside good classroom instruction to prepare students for assessment experiences;
- That they are evaluating students against common reference points shared by all Ohio educators;
- That they are preparing students for the statewide diagnostic and achievement tests.

In this way Ohio's aligned system helps ensure that all students are prepared to meet the rigorous demands of the new century.

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# ACADEMIC CONTENT STANDARDS

K-12 Technology

# Glossary



# ACADEMIC CONTENT STANDARDS

<b>A</b>	
<b>AUP</b>	Acceptable Use Policy—A policy prepared by a school district or educational agency that identifies the rules governing appropriate use of district technology resources and the Internet. The AUP specifies expectations for student behavior and outlines consequences to be applied to the student in response to inappropriate use of district technology resources and the Internet. Parents and / or guardians are required to sign the AUP verifying that they give permission for their child to use the district technology resources and the Internet and that they understand the expectations and consequences. It is recommended that the AUP is given to students and parents as part of the beginning of the school year activities, along with medical forms and other parent information. It is recommended that a new form is issued and signed every year.
<b>acidity - pH</b>	A measure of the extent a solution is acid; may also be referred to as alkalinity.
<b>ADA</b>	Americans with Disabilities Act—This law sets accessible design standards in employment, government services, public accommodations, commercial facilities, communication and transportation.
<b>agriculture</b>	The raising of crops and animals for food, feed, fiber, fuel or other useful products.
<b>alt attributes / tags</b>	In this instance, alt attributes refer to tags that identify descriptors of Web site elements and may increase accessibility; e.g., name of participants in a photo, description of image or video, link to the displayed content in another form.
<b>alternative energy source</b>	Any sources or resources of energy that are renewable through natural processes can be renewed artificially or that are regarded as practically inexhaustible. These include solar, wind, geothermal, biomass and wood resources. Also referred to as renewable energy.
<b>alternative fuel</b>	Transportation fuels other than gasoline or diesel. Includes natural gas, methanol, ethanol, propane, hydrogen and electricity.
<b>ANSI</b>	American National Standards Institute—This agency administers the US voluntary standardization and conformity assessment system. Committees represent approximately 10,500 technical and product standards.
<b>anthropometric data</b>	Data charts that show the size ranges by percentiles for children and adults by gender. Used in making the ergonomic fit of potential uses to new product and architectural designs. A conventional design of the human figure; resembling a human in form or in attributes.
<b>artifact</b>	A human-made object.
<b>artificial ecosystem</b>	Human-made environment or system that functions as a replication of or to produce the equivalent of the natural environment.

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<b>assessment</b>	<ol style="list-style-type: none"><li>1. An evaluation technique for technology that requires analyzing benefits and risks, understanding the trade-offs and determining the best action to take in order to ensure that the desired positive outcomes outweigh the negative consequences.</li><li>2. An exercise, such as an activity, portfolio, written test or experiment that seeks to measure a student's skills or knowledge in a subject area. Information may be collected about teacher and student performance, student behavior and classroom atmosphere.</li></ol>
<b>ATM</b>	Asynchronous Transfer Mode—Refers to networks that support "real-time" voice, video and data.
<b>attributes of design</b>	That it is purposeful, based on requirements, systematic, iterative, creative and provides solution and alternatives.
<b>B</b>	
<b>batch production</b>	The process of producing parts or components in specific or limited quantity to be assembled into larger products.
<b>Bernoulli's Principle</b>	The law that for nonviscous, incompressible fluid in a steady flow, the sum of the pressure, potential and kinetic energies per unit of volume is constant at any point. A fundamental law in fluid mechanics.
<b>biodegradable</b>	The ability of a substance to be broken down physically and/or chemically by natural biological processes such as by being digested by bacteria, fungi and other organisms.
<b>biodiesel</b>	A biodegradable transportation fuel for use in diesel engines produced through a blending of oils from plants, animal fat, agricultural byproducts and used cooking oils that can be blended with traditional petroleum-based diesel fuel.
<b>bioengineering</b>	Engineering applied to biological and medical systems such as biomechanics, biomaterials and biosensors. Bioengineering also includes biomedical engineering to develop aids or replacements for defective or missing body organs.
<b>biomass</b>	Organic materials and waste used in the production of energy. Sources include food-processing waste, agricultural crops, crop-waste residues, wood, animal and municipal wastes, aquatic plants and fungal growth.
<b>biorelated technology systems</b>	These systems focus on the practical application of physical components and biological products, substances or organisms (agriculture, medical technology or biological processes) that provide improved functioning, health or contribute to the harmony between living beings and their environment.
<b>biotechnology</b>	Any technique that uses living organisms or parts of organisms to make or modify products, improve plants or animals or to develop microorganisms for specific uses. Biorelated processes include propagating, growing, harvesting, adapting, treating and converting.

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<b>blog/Weblog</b>	A Weblog (sometimes shortened to blog or written as "Web log") is a Web site of personal or noncommercial origin that uses a dated log format updated on a daily or very frequent basis with new information about a particular subject or range of subjects.
<b>Boolean operators/ searching</b>	Searching that allows a researcher to combine keywords and phrases. The words AND, OR, NOT and BUT NOT are known as Boolean operators and can be used to join the descriptors. Words can be truncated to allow for variant forms of a word. In this manner, a researcher can limit or expand results based on potential usefulness. The name comes from George Boole, a 19th-century English mathematician and logician. Example Boolean operators: John AND Glenn, Astronaut NOT Senator. Example truncation: educat*.
<b>brainstorming</b>	A method of shared problem-solving in which all members of a group spontaneously and in an unrestrained discussion generate ideas.
<b>byproduct</b>	Something produced in the making of something else; a secondary result; a side effect.
<b>C</b>	
<b>CAD</b>	Computer-aided design or computer-aided drafting—1. (Design) The use of specialized computer software to assist in the process of designing a part, circuit, building, etc. 2. (Drafting) The use of a computer to assist in the process of creating, storing, retrieving, modifying, plotting and communicating a technical drawing.
<b>capital</b>	One of the basic resources used in a technological system. Capital (money) is the accumulated finances and goods devoted to the production of other goods.
<b>characteristics of technology</b>	Three characteristics include: technology involves tools, materials, knowledge and systems; applications of technology result in artifacts (things or items); and technology is developed by people to control natural and human-made environments.
<b>chat</b>	"Real-time" electronic talk/ chat between users over the Internet, local network or bulletin board system. Chat is transmitted live via the keyboard. Chat is a forerunner of instant messaging. A chat room is a discussion about a specific topic. Unlike e-mail, chat and instant-messaging are in "real-time." Users choose to chat or join a chat room; e.g., a teacher may choose to enter the mathematics education chat room.
<b>closed-loop system</b>	A system that uses feedback from the output to control the input.
<b>communication technology systems</b>	These systems reflect technology that involves the use of devices or methods to collect, process, store or deliver information using electronic and graphic means. Processes include encoding, transmitting, receiving, storing, retrieving and decoding.
<b>complex system</b>	A system consisting of interconnected or interwoven parts that interact to produce a global output that cannot always be predicted.



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<b>computer and multimedia literacy</b>	Computer and multimedia literacy includes the ability to appropriately use hardware, software applications, multimedia tools and other electronic technology. It harnesses the use of educational technology tools for productivity, communication, research and problem-solving.
<b>constraint</b>	A limit to the design process. Constraints related to product appearance, funding, space, materials and human capabilities.
<b>construction</b>	The systematic act or process of building, erecting or constructing buildings, roads or other structures. Construction processes include preparing the site, building the structure and completing the site.
<b>connectivity</b>	The extent to which resources, users and devices are efficiently linked together.
<b>continuous production</b>	Method of producing an article continuously and, in theory, indefinitely.
<b>contradictions</b>	In a technical contradiction, improvement in one desired characteristic of a system results in the deterioration of another.
<b>control</b>	An arrangement of chemical, electronic, electrical and mechanical components that commands or directs the management of a system.
<b>control system</b>	An assemblage of control apparatus coordinated to execute a planned set of actions.
<b>convention</b>	A technique, practice or procedure that is established by use and widely accepted.
<b>copyright</b>	A legal right to publish a work for a specific number of years.
<b>core concepts of technology</b>	Include systems, resources, requirements, optimization and trade-offs, processes and controls.
<b>criterion</b>	A desired specification (element or feature) of a product or system.
<b>critical thinking</b>	The ability to acquire information, analyze and evaluate it and reach a conclusion or answer by using logic and reasoning skills.
<b>CT-Scan</b>	Computerized Tomography Scanner is a method of reconstructing cross-sectional images of the body by using rotating X-ray sources and detectors which move around the body and record X-ray transmissions throughout the 360-degree rotation.
<b>custom production</b>	A type of production in which products are designed and built to meet the specific needs and wants of an individual.
<b>D</b>	
<b>data</b>	Raw facts and figures that can be used to draw a conclusion.
<b>dead load / live load</b>	1. The weight of the materials used to build a structure. 2. The weight of moveable and variable loads placed on a building.

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<b>decode</b>	To convert an encoded message into understandable form using ordinary language.
<b>demanufacturing</b>	Organized process for dismantling unwanted products to obtain valuable components and materials for reprocessing and safe disposal on remaining product parts. Products may be designed for ease in recycling after their use.
<b>design</b>	An iterative decision-making process that produces plans by which resources are converted into products or systems that meet human needs and wants or solve problems.
<b>design principles</b>	Design rules regarding rhythm, flexibility, unity, balance, proportion, variety, emphasis, harmony and function used to evaluate existing designs and guide the design process.
<b>design process</b>	A systematic problem-solving strategy, with criteria and constraints, used to develop many possible solutions to a problem. Typical steps include identifying need, research, generating alternative solutions, modeling best idea, testing and evaluation, and redesign.
<b>diagnose</b>	To determine, by analysis, the cause of a problem or the nature of something.
<b>digital content</b>	The multimedia material that allows students to seek and manipulate information. Includes primary and secondary sources such as images, sound, video and other artifacts converted to digital format.
<b>digitization</b>	Converting of information (print materials, sound, pictures) into a digital format.
<b>distance learning</b>	Synchronous or asynchronous interactive instruction method by which students are located geographically distant from the instructor; e.g. online courses and videoconferencing.
<b>DNA</b>	Deoxyribonucleic acid—Recombinant DNA technique is the code that describes the genetic material of most organisms.
<b>domain</b>	A unique Web site name on the World Wide Web. Among the most common are: -.com (commercial), -.edu (educational); -.gov (governmental); -.org (noncommercial organization).
<b>drawing</b>	A work produced by representing an object or outlining a figure, plan or sketch with lines. A drawing communicates ideas and provides direction for design production.
<b>durable goods</b>	Items that can be used for many years.
<b>E</b>	
<b>electric circuit</b>	The complete path of electric current flowing through electrical loads like conductors or devices.
<b>electronic media</b>	A comprehensive term for media supported by computers and other electronic means such as DVDs, CD-ROMS and e-books. Programs that combine text with audio and video are frequently referred to as multimedia programs.

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<b>electronic pathfinder</b>	Bibliographies and other such documents that serve as guidelines to research. These usually focus on a single topic and can be very narrow in scope, but they bring together a variety of resources in multiple formats that relate to that topic. They may be annotated for added usefulness.
<b>encode</b>	To change a message into symbols or a form that can be transmitted by a communication system.
<b>energy</b>	The ability to do work. Can apply to thermal, radiant, mechanical, electromagnetic, chemical, etc. resources.
<b>energy/power</b>	Technology system focuses on the practices used to develop, install and maintain machines and other devices that support all fields of technology. Energy use and power application processes include controlling, converting, transmitting.
<b>engineer</b>	A person who is trained in and uses technological and scientific knowledge to solve practical problems.
<b>engineering</b>	The profession of or work performed by an engineer. Engineering involves the knowledge of the mathematical and natural sciences (biological and physical) gained by study, experience, and practice that are applied with judgment and creativity to develop ways to use the materials and forces of nature for the benefit of mankind.
<b>engineering design</b>	The systematic and creative application of scientific and mathematical principles to practical ends such as the design, manufacture and operation of efficient and economical structures, machines, processes and systems.
<b>environment</b>	The complex of physical, chemical and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and, ultimately, determine its form and survival.
<b>environmental health</b>	Concerns the interface between human health and health stressors from the environment. Stressors may be physical, chemical, biological or psychological and carried in the air, water, soil or food. Solutions may include personal responses, political and legal processes, environmental controls and waste and materials management.
<b>environmental probe</b>	Computer peripheral device used to sense environmental data (sensors for pH, humidity, temperature, air quality, etc) and transmit data to a computer for processing.
<b>EPA</b>	Environmental Protection Agency is the federal agency responsible for regulation of most chemicals that enter the outdoor environment. The state-level agency with these responsibilities is the Ohio EPA.
<b>ergonomics</b>	The study of workplace equipment design or how to arrange and design devices, machines or workspace so that people and things interact safely and most efficiently. Also called human factors analysis or human factors engineering.

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<b>ethical</b>	Conforming to an established set of principles or accepted professional standards of conduct. Ethical use includes using resources legally and with respect to copyright and other limitations on use as well as to protocols and restrictions placed on the use of computers and networks.
<b>ethical use</b>	Using resources legally and with respect to copyright and other limitations on use as well as to protocols and restrictions placed on the use of computers and networks. Such use should be well defined in Acceptable Use Policies.
<b>ethanol</b>	Ethyl alcohol, alcohol or grain spirit used as a gasoline octane enhancer made from biomass materials such as corn. Grades include E10 - 10 percent ethanol / 90 percent petroleum; E85 and gasohol.
<b>evaluation</b>	1. The collection and processing of information and data to determine how well a design meets the requirements and to provide direction for improvements; 2. A process used to analyze, evaluate and appraise a student's achievement, growth and performance through the use of formal and informal tests and techniques.
<b>experimentation</b>	1. The act of conducting a controlled test or investigation; 2. The act of trying out a new procedure, idea or activity.
<b>exponential development</b>	Describes the rapid growth or adoption rate of some technological inventions or innovations in which a visual representation of the technology data looks like the J curve.
<b>F</b>	
<b>fact</b>	A statement or piece of information that is true or a real occurrence.
<b>FCC</b>	Federal Communication Commission is an independent government agency focused on interstate and international communications using radio, television wireless, satellite, cable and appliances that emit radio frequencies.
<b>feedback</b>	Using all or a portion of the information from the output of a system to regulate or control the processes or inputs in order to modify the output.
<b>feral</b>	A domesticated animal that has reverted to the wild, or a product, like batteries, discarded in natural or built-environment setting.
<b>forecast</b>	A statement about future trends, usually as a probability, made by examining and analyzing available information. A forecast also is a prediction about how something will develop, usually as a result of study and analysis of available pertinent data.
<b>form follows function</b>	A design principle suggesting that the end use or purpose of an item or product should help set the criteria for the design and fabrication of the item or product produced.
<b>forming</b>	The process that changes the shape and size of a material without cutting it; e.g., forging.

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<b>forty principles</b>	A listing of common technical design solutions, developed from an analysis of patents, used in problem-solving for removing or resolving technical contradictions often encountered by inventors.
<b>G</b>	
<b>Gantt charts</b>	Visual presentation report device for showing all the major elements in a project schedule and the relationship of project elements over time.
<b>GPS</b>	Global positioning systems are used to provide an extremely accurate three-dimensional position and velocity information to users anywhere in the world. Data is derived from the transit time of radio frequency signals from multiple satellites.
<b>goal-directed research</b>	Efforts to solve a very specific problem or product-development goal.
<b>GIS</b>	Graphic/geographic Information Systems present digitized information in a visual map format.
<b>graphic files</b>	Formats for storing high-quality images. Types include GIF, graphics interchange format; JPEG, joint photographic experts group; TIFF, tagged image file format.
<b>graphic organizer</b>	A visual or graphic display that shows the links between concepts, technical content, design solutions, research topics, etc.
<b>guidance system</b>	A system that provides information for guiding the path of a vehicle by means of built-in equipment and control.
<b>H</b>	
<b>heat engine</b>	Devices like the internal combustion and diesel engines, steam engines and turbines that generate electricity are examples of engines that use heat-generated energy and convert it into mechanical energy or motion.
<b>heat transfer</b>	The process by which thermal energy is transmitted through a material or body without movement of the medium itself; 1. Conduction, energy transfer between objects in physical contact; 2. Convection, energy transfer through a fluid (gas, liquid or plasma) at varying densities; 3. Radiation, energy transfer through the emittance of electromagnetic radiation.
<b>HVAC</b>	Heating, ventilation, air conditioning control describes the category of heating and cooling systems in a structure. The American Society of Heating, Refrigeration, Air-Conditioning Engineers is the professional group representing this field.
<b>hydraulic and pneumatic systems</b>	Power systems that use either fluids under pressure or compressed air as the energy source. Typically, pressurized hoses or piping are used to transmit power to actuate cylinders that create mechanical energy to operate a device.
<b>hydroponics</b>	A technique of growing plants without soil, in water or sometimes an inert medium like sand flooded with dissolved nutrients.

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<b>HTML</b>	Hypertext Markup Language is the computer language used to create World Wide Web pages, with hyperlinks and markup for text formatting.
<b>HTTP</b>	Hypertext Transport Protocol sets the rules by which World Wide Web browsers and servers communicate. Used to transfer information from Web servers to browsers.
<b>I</b>	
<b>impact</b>	The effect or influence of one thing on another. Some impacts are anticipated and others are unanticipated. Results can be positive or negative.
<b>information system</b>	A system of elements that receive and transfer information. This system may use different types of carriers, such as satellites, fiber optics, cables and telephone lines in which switching and storage devices are often important parts.
<b>infrastructure</b>	1. The basic framework or features of a system or organization. 2. The basic physical systems of a country's or a community's population including transportation and utilities.
<b>innovation</b>	An improvement of an existing technological product, system or method of doing something.
<b>input</b>	Resource that flows into a technological system.
<b>integration</b>	The process of bringing all parts together into a whole.
<b>insulator</b>	A material that does not allow energy to move freely through it.
<b>instant messaging</b>	Similar to chat except that users must be logged in to an IM (instant messaging service) and approve other users to be part of their IM system (known as a "buddy list"). When the user logs in, he or she will receive a list of all other users on the buddy list who are also logged in. The messaging is in real-time and may increase productivity when working in a team-based environment. The discussions may be focused more toward specific work of the team. IM is different from a chat room in that the user approves other users (buddies); e.g., chat room user may choose to enter the mathematics education chat room- IM user approves the mathematics teachers in his or her particular school.
<b>IEEE</b>	International Electrical and Electronic Engineers is the professional group that sets technical and safety standards for computer engineering, biomedical technology, telecommunications, electric power production, aerospace and consumer electronics.
<b>ISO</b>	International Standards Organization represents 148 national standards institutes in the development of specifications for materials, manufacture and supply of products, testing and analysis, terminology, provision of services. ISO 9000 for quality management and ISO 14000 for environmental management are the major groupings of standards.

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<b>intellectual property</b>	Work that is created by an individual, e.g. fiction, nonfiction, computer programs, musical and artistic works. These works are generally covered by copyrights, but a creator need not have an item copyrighted to retain such rights. Sometimes the intellectual property may be owned by the creator's employer.
<b>intermodalism</b>	The use of more than one form of transportation to meet a need.
<b>invasive species</b>	Categories of nonnative plants, insects, birds, mammals, fish, aquatic organisms, etc. that have aggressive growth patterns and may have a negative impact on native species, agriculture production and the local economy.
<b>IP address</b>	A unique number identifying each host machine on the Internet network.
<b>irradiation</b>	Treatment through the use of ionizing radiation, such as X-rays or radioactive sources (e.g., radioactive iodine seeds).
<b>iterative</b>	Describing a procedure or process, like design, that repeatedly executes a series of operations until some condition is satisfied. An iterative procedure may be implemented by a loop in a routine.
<b>J</b>	
<b>just-in-time</b>	JIT manufacturing is a systems approach to developing and operating a manufacturing system, in which manufacturing operation component parts arrive <i>just in time</i> to be picked up by a worker and used, so the need to maintain a parts inventory is avoided.
<b>K</b>	
<b>kinetic energy</b>	The energy possessed by a body as a result of its mass and motion.
<b>L</b>	
<b>lean production</b>	Manufacturing practices emphasizing effective and highly efficient production methods that focus on value-added activities while minimizing nonvalue-added activities.
<b>levels of innovation</b>	Five levels including: 1. Apparent or conventional solution; 2. Small invention inside paradigm; 3. Substantial invention inside technology; 4. Invention outside technology; 5. Discovery.
<b>LIST serv</b>	A distribution list for sending e-mail information to a targeted list of participants. Also known as e-list.
<b>LAN</b>	Local area networks are communications systems that link several computer devices and allow them to use each other's resources. Linked devices may include computers, terminals, printers and disk drives.

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<b>M</b>	
<b>machine</b>	A device with fixed and moving parts that modifies mechanical energy in order to do work.
<b>manufacturing</b>	The process of making a raw material into a finished product, especially in large quantities.
<b>manufacturing system</b>	A system or group of systems used in the manufacturing process to make goods and products for an end user. These processes include separating, combining, forming/conditioning and finishing.
<b>market</b>	A subset of the population considered to be interested in buying goods or services.
<b>mass production</b>	The manufacture of goods in large quantities using machines, standardized design and parts and, often, assembly lines.
<b>material</b>	The tangible substance (chemical, biological or mixed) that goes into the makeup of a physical object. One of the basic resources used in a technological system.
<b>material safety data sheets</b>	MSDS are fact sheets provided by manufacturers listing the characteristics, safe handling, use and disposal for all products that contain chemicals.
<b>media literacy</b>	The ability to access, interpret, evaluate and communicate information delivered in a variety of media formats, print and nonprint, which use image, language and sound to convey information.
<b>medical technology</b>	Of or relating to the study of medicine through the use of and advances in technology such as medical instruments and apparatus, imaging systems in medicine and mammography. Related terms: biomedical engineering and medical innovations.
<b>MIDI</b>	Musical Instrument Digital Interface - Industry standard for digital control of musical instruments.
<b>mixed-natural materials</b>	Natural materials modified to improve their properties. Mixed-natural materials may be leather, plywood or paper, for example.
<b>model</b>	A visual, mathematical or three-dimensional representation in detail of an object or design, often smaller than the original. A model is often used to test ideas, make changes to a design and learn more about what would happen to a similar, real object.
<b>MPEG</b>	Moving Pictures Expert Group—a file format for dynamic images.
<b>MRA, MRI</b>	Magnetic Resonance Angiography, Magnetic Resonance Amplifier, Magnetic Resonance Imaging are medical technologies for obtaining detailed three dimensional scans of the human body.
<b>multimedia</b>	Information that is mixed and transmitted from a number of formats (e.g., video, audio and data).



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<b>N</b>	
<b>NEC</b>	National Electric Code developed by the National Fire Protection Association sets national standard building codes for wiring, general electric equipment, specific types of structures and applications, safe installation, maintenance and use.
<b>NTSB</b>	National Transportation Safety Board is responsible for accident investigations and making safety recommendations in the areas of aviation, highway, marine, pipeline and hazardous materials, railroad, intermodal and transportation disaster assistance.
<b>NIOSH</b>	The National Institute for Occupational Safety and Health is part of the Centers for Disease Control and Prevention (CDC) and is the only federal institute responsible for conducting research and making recommendations for prevention of work-related illnesses and injuries.
<b>natural material</b>	Material found in nature, such as wood, stone, gases and clay.
<b>netiquette</b>	A common term referring to proper behavior and practice on a network, following expected etiquette.
<b>noise</b>	An outside signal that interrupts, interferes or reduces the clarity of a transmission.
<b>nondurable goods</b>	Items that do not last and are constantly consumed such as paper products.
<b>nonrenewable</b>	An object, thing or resource that cannot be replaced such as nonrenewable energy resources.
<b>nuclear power</b>	Power, the source of which is nuclear fission.
<b>O</b>	
<b>OSHA</b>	Occupational Safety and Health Administration is the federal agency in the U.S. Department of Labor that regulates workers' exposures to hazardous substances and requires manufacturers of products containing chemicals to develop an MSDS for each brand.
<b>Ohm's Law</b>	Basic electrical law describing the relationships of voltage, current and resistance. Voltage to force current through a circuit is equal to current multiplied by resistance, $E = I \times R$ ; current flowing through a circuit is equal to the voltage divided by resistance, $I = E \div R$ ; resistance within a circuit is equal to its voltage divided by the amount of current, $R = E \div I$ .
<b>open-loop system</b>	A control system that has no means for comparing the output with input for control purposes. Control of open-loop systems often requires human intervention.
<b>open-source software and systems</b>	Program languages and devices that are designed to permit other software developers and inventors to develop products that utilize these resources.

# ACADEMIC CONTENT STANDARDS

<b>OCR</b>	Optical character recognition is a capability of devices with electronic scanners to read numbers, letters and other characters and convert the optical images into appropriate electric signals.
<b>optimization</b>	An act, process or methodology used to make a design or system as effective or functional as possible within the given criteria and constraints.
<b>online</b>	Using the Internet by modem, broadband or other means.
<b>output</b>	The results of the operation of any system.
<b>outsourcing</b>	Practice of companies downsizing their organization to contract work and functions they would normally perform, to outside contractors in other geographic regions and countries.
<b>P</b>	
<b>passive solar</b>	Building practice that places and designs buildings so that they take maximum advantage of the natural seasonal warming power of the sun.
<b>patent laws</b>	A patent is granted by the U.S. Government giving inventors the right to exclude all others from making, using or selling their inventions within the United States, its territories, and possessions. There are three kinds of patents: utility patents cover new and useful processes, machines, manufacturing; plant patents for new varieties of asexually reproduced plants and design patents cover new ornamental design for an article of manufacture.
<b>physical technology systems</b>	These systems reflect technology that involves the construction or manufacturing of products. Physical technology also encompasses the transportation of organic and inorganic materials and the production and distribution of energy.
<b>plastic packaging resin codes</b>	1. PETE, PET, Polyethylene Terephthalate; 2. HDPE, High Density Polyethylene; 3. PVC, Polyvinyl Chloride; 4. LDPE, Low Density Polyethylene; 5. PP, Polypropylene; 6. PS, Polystyrene; 7. Other
<b>plug-ins</b>	Software accessory programs installed on a computer that work in conjunction with a Web browser to give it added capabilities such as the ability to play sounds or video.
<b>pollution</b>	The changing of a natural environment, either by natural or artificial means, so that the environment becomes damaged or unfit for living things; especially applicable to the contamination of soil, water or the atmosphere by the discharge of harmful substances.
<b>power system</b>	A technological system that transforms energy resources to power.
<b>problem-solving</b>	The process of understanding a problem, devising a plan, carrying out the plan and evaluating the plan in order to solve a problem or meet a need or want.
<b>product</b>	A tangible artifact produced by means of either human or mechanical work or by biological or chemical processes.

# ACADEMIC CONTENT STANDARDS

<b>product lifecycle</b>	Stages a product goes through from concept and use to eventual withdrawal from the marketplace. Product lifecycle stages include research and development, introduction, market development, exploitation, maturation, saturation and, finally, decline.
<b>production system</b>	A technological system that involves producing products and systems by manufacturing (on the assembly line) and construction (on the job site).
<b>propulsion system</b>	A system that provides the energy source, conversion and transmission of power to move a vehicle.
<b>prototype</b>	A full-scale working model used to test a design concept by making actual observations and necessary adjustments.
<b>Q</b>	
<b>quality control</b>	A system by which a desired standard of quality in a product or process is maintained. Quality control usually requires feeding back information about measured defects to further improvements of the process.
<b>R</b>	
<b>R value</b>	A measure of thermal resistance that describes the property of a material that resists the flow of heat through the material.
<b>real-time</b>	Output resulting simultaneously with a system input (synchronous).
<b>receiver</b>	The part of a communication system that picks up or accepts a signal or message from a channel and converts it to perceptible forms.
<b>recycle</b>	To reclaim or reuse old materials in order to make new products. Collecting and remelting or reprocessing of a resource so it can be used again.
<b>renewable</b>	Designation of a commodity or resource, such as solar energy or firewood, that is inexhaustible or capable of being replaced quickly by natural ecological cycles or sound management practices.
<b>requirements</b>	The parameters placed on the development of a product or system. The requirements include the safety needs, the physical laws that will limit the development of an idea, the available resources, the cultural norms and the use of criteria and constraints.
<b>research and development</b>	R and D is the practical application of scientific and engineering knowledge for discovering new knowledge about products, processes and services, and applying that knowledge to create new and improved products, processes and services that fill market needs.
<b>research process</b>	The method by which an individual goes about defining information needs, locating and using information, and creating new information.

# ACADEMIC CONTENT STANDARDS

<b>resources (systems)</b>	The things needed to get a job done. In a technological system, the basic technological resources are energy, capital, information, machines and tools, materials, people and time.
<b>resources (information)</b>	In library media centers, resources are all the materials that comprise a collection and meet the demands of the curriculum and students' personal and academic needs. Resources include print and nonprint materials (video, audio, electronic) and the equipment to make full use of them.
<b>riparian</b>	A natural buffer or corridor along a waterway, between the water and developed areas, that protects water quality by filtering overland run off from agricultural, residential, roadway, commercial and industrial properties.
<b>risk</b>	The chance or probability of loss, harm, failure or danger.
<b>S</b>	
<b>sanitation</b>	The design and practice of methods for solving basic public health problems such as drainage, water and sewage treatment and waste removal.
<b>scale</b>	A proportion between two sets of dimensions used in developing accurate, larger or smaller prototypes or models of design ideas.
<b>schematic</b>	A symbolic representation such as a drawing or diagram of a chemical, electrical or mechanical system.
<b>search directory</b>	A Web searching site that catalogs or organizes the site by subject. The directory serves as an index.
<b>search engine</b>	The software and algorithms used to perform searches on a Web site.
<b>search strategy</b>	The systematic method or process used to locate and use information needed at any given time. It can be simple or complex, varying with the nature of the need.
<b>separation principles</b>	Separation principles overcome contradictions in systems (e.g., time, space, combining or dividing systems, physical-chemical changes).
<b>seven technological systems</b>	The technological systems areas include energy and power technologies, transportation technologies, manufacturing technologies, construction technologies, information and communication technologies, medical technologies, agricultural and related biotechnologies.
<b>six sigma</b>	Business management strategy to increase profits by eliminating variability, defects and waste, and improve customer satisfaction. Goal is only 3.4 defects per million part/opportunities; following a structured problem-solving process; and customer-focused and data driven.
<b>solar energy</b>	Usable energy derived directly from sunlight. Solar energy can be captured using technologies such as photovoltaics, solar thermal systems and passive and active solar construction.
<b>sound files (AVI, WAV, MPEG)</b>	Audio video interleaved, wav format for storing audio files in Windows, moving pictures experts group.

# ACADEMIC CONTENT STANDARDS

<b>standardization</b>	The act of checking or adjusting by comparison with a standard.
<b>state-of-the-art</b>	Contemporary technological practice.
<b>statistical process control</b>	SPC—quality control procedure that uses the application of statistical methods to identify and control situations that cause variation in a process.
<b>statistical tools</b>	Process of using wide ranging and interacting data to understand processes, problems and solutions (measures of central tendency, linear regression, symbolic logic, non-decimal number systems).
<b>streaming video</b>	A sequence of "moving images" that are sent in compressed form over the Internet and are displayed by the viewer as they arrive.
<b>structure</b>	Something that has been constructed or built of many parts and held or put together in a particular way.
<b>subsystem</b>	A division of a system that, in itself, has the characteristics of a system.
<b>sustainability</b>	The ability to maintain interdependence of the environmental, social and economic systems. 1. Of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged. 2. Relating to a human activity that can be sustained over the long term without adversely affecting the environmental conditions (soil conditions, water quality, climate) necessary to support those same activities in the future.
<b>synchronous</b>	Coordinated events that are not in "real-time" e.g., voice and video that is available for download but not "live."
<b>synthetic material</b>	Material that is not found in nature, such as glass, concrete and plastics.
<b>system</b>	A group of interacting, interrelated or interdependent elements or parts that function together as a whole to accomplish a goal.
<b>system dynamics</b>	Potential for change in a system and its subsystems.
<b>systems-oriented thinking</b>	A technique for looking at a problem in its entirety, looking at the whole as distinct from each of its parts or components. Systems-oriented thinking takes into account all of the variables and relates social and technological characteristics.

## T

<b>technological literacy</b>	Technological literacy addresses the abilities needed to participate in a technological world. It is the intersection of mathematics, science and technology. It specifies unique knowledge, devices and capabilities that are used to solve problems. It identifies career connections between technology and the world of work. Technological literacy includes technology education and pre-engineering concepts.
<b>technological transfer</b>	The process by which products, systems, knowledge or skills, developed under federal research and development funding, are translated into commercial products to fulfill public and private needs.

# ACADEMIC CONTENT STANDARDS

<b>technology systems</b>	Define the content which is unique to the study of technology and relates this content to other disciplines. Technology systems categories include physical technology systems, communication technology systems and biorelated systems.
<b>telecommunications</b>	The movement of information through a network via electrical means.
<b>telemedicine</b>	The investigation, monitoring and management of patients and the education of patients and staff using systems which allow ready access to expert advice and patient information, no matter where the patient or the relevant information is located. The three main dimensions of telemedicine are health service, telecommunications and medical computer technology.
<b>thermodynamics</b>	The study of the transformations of energy. It is the basis for the study of the efficient working of engines. Laws include: 1. The internal energy of a system is constant unless it is changed by doing work or heating. 2. It is impossible for an unaided self-acting machine to convey heat to another body at a higher temperature.
<b>trade-off</b>	An exchange of one thing in return for another, especially relinquishing one benefit or advantage for another regarded as more desirable.
<b>trademark</b>	A trademark, brand name or logo is a word, name, symbol, design, combination of word and design or slogan used by a manufacturer or merchant to identify its goods or services and distinguish them from those manufactured or sold by others. When it is used for services, it is called a service mark.
<b>transmit</b>	To send or convey a coded or noncoded message from a source to a destination.
<b>transportation system</b>	The process by which passengers or goods are moved or delivered from one place to another. Transportation processes include receiving, holding / storing, loading, moving, unloading and delivering.
<b>trend analysis</b>	A comparative study of the component parts of a product or system and the tendency of a product or system to develop in a general direction over time.
<b>trial and error</b>	A method of solving problems in which many solutions are tried until errors are reduced or minimized.
<b>troubleshoot</b>	Following a step-by-step process to locate and find the cause of problems related to technological products or systems.
<b>truss designs</b>	Pattern of cords and webs to create a strong, light-weight structural support. An assembly of members, such as beams, bars and rods, combined to form a rigid framework, often used in roof construction.
<b>U</b>	
<b>Universal Design</b>	Design of products and environments based on principles of equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, size and space for approach and use. Represented in meeting ADA design standards.

# ACADEMIC CONTENT STANDARDS

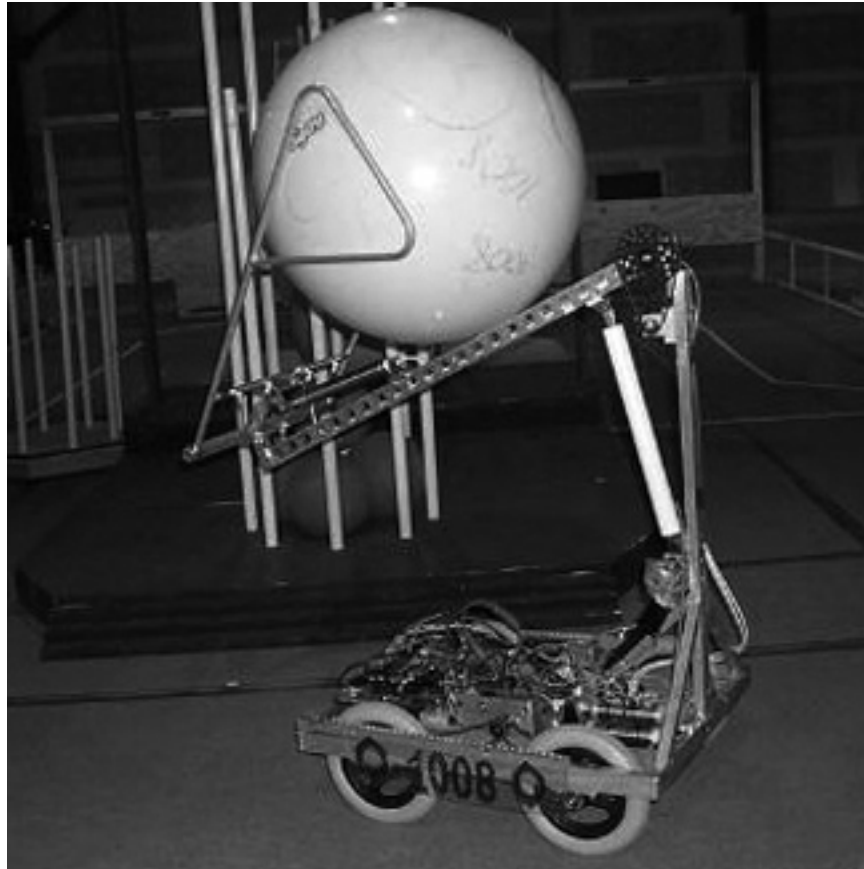
<b>USB</b>	Universal Serial Bus is a versatile bus system for personal computers that provides transfer speed about 10 times faster than older standards.
<b>URL</b>	Universal Resource Locator. <a href="http://www.ode.state.oh.us/academic_content_standards/">http://www.ode.state.oh.us/academic_content_standards/</a> http: (protocol-hypertext transport protocol) // (separators) www.ode.state.oh.us (domain name) www (world wide web) ode (name of Web site Ohio Department of Education) state (domain- state government entity in Ohio) us (domain- state government entity in Ohio in the United States) academic_content_standards subdirectory name- location of file or page to be accessed).
<b>V</b>	
<b>virtual</b>	Simulation of the real thing in such a way that it presents reality in essence or in effect, though not in actual fact.
<b>voice over IP</b>	voIP - Voice over Internet protocol. It is the transmission of telephone calls over a data network such as one of the many networks that make up the Internet.
<b>voice-recognition tools</b>	Devices that include a system that allows users to "train" computers to understand their voices and vocabulary. The user must follow only the patterns the computer is programmed to recognize.
<b>W</b>	
<b>waste</b>	Refuse or byproducts perceived as useless, and must be consumed, left over, processed or thrown away.
<b>Web browser</b>	Browser - A program that allows users to access and manipulate hypertext documents on the World Wide Web, and navigate between them. Browsers can be text based or graphic.
<b>Web casting</b>	Real-time distribution of video over a network.
<b>wide area network (WAN)</b>	A network designed to provide service to a wide geographic area such as a college campus.
<b>Wi - Fi - Wireless fidelity</b>	A specific type of wireless network, the 802.11 network, where encoded data is sent via radio wave, received and decoded by the user.
<b>WWW</b>	World Wide Web is an international system of Internet servers that allows documents formatted in hypertext markup language (HTML) to be transferred via the Internet by a process called HTTP (hyper-text transfer protocol). The protocol also allows random access to audio, video and graphics files, as well as other documents.

# ACADEMIC CONTENT STANDARDS

Z

Zip

Data compression and file packaging protocol for personal computers.





K-12 Technology

# Resources



# ACADEMIC CONTENT STANDARDS

These sample resources can be used to understand Ohio's technology academic content standards. In addition, these resources can be used to begin implementing standards-based instruction and assessment in technology. When developed, the model curriculum for technology will provide a greater opportunity to explore best practices, research-based instruction and effective lessons and strategies for all children.

## Research Resources

Resources listed in this section are samples of the available information about programmatic research and publications helpful in building knowledge and understanding of standards as well as other related technology benchmark topics.

### A) *Print Resources*

- American Association for the Advancement of Science. *Project 2061, Benchmarks for Science Literacy*. New York: Oxford University Press, 1993.
- American Association of School Librarians and Association for Educational Communications and Technology. *Information Power: Building Partnerships for Learning*. Chicago: American Library Association, 1998.
- Meredith Davis, Peter Hawley, Bernard McMullan, Gertrude Spilka. *Design as a Catalyst for Learning*, Alexandria, Virginia: Association for Supervision and Curriculum Development, 1997.
- International Society for Technology in Education. *National Education Technology Standards for Administrators*, 2003.
- International Society for Technology in Education. *National Educational Technology Standards for Students: Connecting Curriculum and Technology*. Eugene, Oregon: International Society for Technology in Education, 2000.
- International Society for Technology in Education. *National Educational Technology Standards for Teachers*, 2003.
- International Technology Education Association. *Technology for All Americans: A Rationale and Structure for the Study of Technology*. Reston, Virginia: International Technology Education Association, 1996.
- International Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology*. Reston, Virginia: International Technology Education Association, 2000.
- International Technology Education Association. *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development and Program Standards*. Reston, Virginia: International Technology Education Association, 2003.
- International Technology Education Association. *Measuring Progress: A Guide to Assessing Students for Technological Literacy*, 2004.
- National Academy of Engineering and National Research Council. *Technically Speaking: Why All Americans Need to Know More About Technology*. Washington, D.C.: National Academy Press, 2002.
- National Aeronautics and Space Administration and Federal Coordinating Council for Science, Engineering, and Technology, Committee on Education and Human Resources. *Pathways to Excellence, A Federal Strategy for Science, Mathematics, Engineering, and Technology Education*. (FY 1994-FY 1998). Washington, D.C.: 1993.

# ACADEMIC CONTENT STANDARDS

- Partnership for 21st Century Skills. *Learning for the 21st Century Report*. Washington, D.C.: Partnership for 21st Century Skills, 2003.
- U.S. Department of Education, Office of Educational Technology. *e-Learning: Putting a World-Class Education at the Fingertips of All Children*. Washington, D.C.: U.S. Department of Education, 2000.
- U.S. Department of Education, Office of Educational Technology. *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge*. Washington, D.C.: U.S. Government Printing Office, 1996.
- U.S. Department of Labor, Secretary's Commission on Achieving Necessary Skills (SCANS): *What Work Requires of School*. Washington, D.C.: U.S. Government Printing Office. 1991.
- Wiggins, G. *Educative Assessment: Designing Assessments to Inform and Improve Student Performance*. San Francisco, California: Jossey-Bass. 1998.
- Wiggins, Grant and Jay McTighe. *Understanding by Design*. 1998.

## B) Internet-based Resources

- Americans With Disabilities Act, ADA Design Standard  
[www.usdoj.gov/crt/ada/stdspdf.htm](http://www.usdoj.gov/crt/ada/stdspdf.htm)
- American National Standards Institute, ANSI Standards  
[www.ansi.org/internet\\_resources/overview/overview.aspx?menuid=12](http://www.ansi.org/internet_resources/overview/overview.aspx?menuid=12)
- The Center for Applied Research in Education Technology (CARET)  
[caret.iste.org](http://caret.iste.org)
- EE Sustainability  
[www.eco-portal.com](http://www.eco-portal.com)
- Federal Communications Commission, FCC Wireless Telecommunications Bureau  
[wireless.fcc.gov](http://wireless.fcc.gov)
- International Standards Organization (ISO)  
[www.iso.org/iso/en/ISOOnline.frontpage](http://www.iso.org/iso/en/ISOOnline.frontpage)
- Milken Exchange on Education Technology  
[www.mff.org/edtech](http://www.mff.org/edtech)
- National Education Technology Plan  
[www.nationaledtechplan.org](http://www.nationaledtechplan.org)
- The National Institute for Occupational Safety and Health (NIOSH)  
[www.cdc.gov/niosh/homepage.html](http://www.cdc.gov/niosh/homepage.html)
- National Skill Standards Board  
[www.nssb.org](http://www.nssb.org)
- No Child Left Behind: A Toolkit for Teachers  
[www.ed.gov/teachers/nclbguide/index2.html](http://www.ed.gov/teachers/nclbguide/index2.html)

# ACADEMIC CONTENT STANDARDS

- North Central Regional Educational Laboratory (NCREL)  
[www.ncrel.org](http://www.ncrel.org)
- Research Center for Educational Technology  
[www.rcet.org](http://www.rcet.org)
- State Education Technology Directors Association (SETDA). *National Leadership Institute Toolkit - States Helping States Implement No Child Left Behind*. 2003.  
[www.setda.org](http://www.setda.org)
- U.S. Copyright Office  
[www.copyright.gov](http://www.copyright.gov)
- U.S. Patent and Trademark Office  
[www.uspto.gov](http://www.uspto.gov)

## Professional Resources

Resources listed in this section are samples of the professional organizations, agencies and technical associations available to help educators stay informed about different technology fields and related technology benchmark topics.

## Professional Organizations

- American Association of School Librarians  
[www.ala.org/aasl](http://www.ala.org/aasl)
- Association for Educational Communications and Technology  
[www.aect.org](http://www.aect.org)
- American Society for Engineering Education (ASEE)  
[www.asee.org](http://www.asee.org)
- Environmental Education Council of Ohio (EECO)  
[www.environmentaleducationohio.org/eohio/index.html](http://www.environmentaleducationohio.org/eohio/index.html)
- International Society for Technology in Education  
[www.iste.org](http://www.iste.org)
- International Technology Education Association  
[www.iteawww.org](http://www.iteawww.org)
- Ohio Academy of Science  
[www.ohiosci.org](http://www.ohiosci.org)
- Ohio Educational Library Media Association  
[www.oelma.org](http://www.oelma.org)
- Ohio Technology Education Association  
[www.otea.info](http://www.otea.info)
- National Society of Professional Engineers (NSPE)  
[www.nspe.org](http://www.nspe.org)

# ACADEMIC CONTENT STANDARDS

- Society for the History of Technology [shot.press.jhu.edu](http://shot.press.jhu.edu)
- Society of Women Engineers [www.swe.org](http://www.swe.org)
- State Educational Technology Directors Association (SETDA) [www.setda.org](http://www.setda.org)

## Departments of Education

- Ohio Department of Education [www.ode.state.oh.us](http://www.ode.state.oh.us)
- Office of Curriculum and Instruction [www.ode.state.oh.us/curriculum-assessment/ci](http://www.ode.state.oh.us/curriculum-assessment/ci)
- Office of Assessment [www.ode.state.oh.us/curriculum-assessment/Assessment](http://www.ode.state.oh.us/curriculum-assessment/Assessment)
- Other state Departments of Education (via CCSSO) [www.ccsso.org/seamenu.html](http://www.ccsso.org/seamenu.html)
- United States Department of Education [www.ed.gov](http://www.ed.gov)
- U.S. Department of Education. Office of Educational Technology Web Page, Initiatives: National Tech Plan, 2003. [www.ed.gov/about/offices/list/os/technology/inits\\_current.html](http://www.ed.gov/about/offices/list/os/technology/inits_current.html)

## Agencies/Associations

- American Institute of Architects [www.aia.org](http://www.aia.org)
- American Institute of Graphic Arts [www.aiga.org](http://www.aiga.org)
- Central Ohio Clean Fuels Coalition [www.cocfc.org](http://www.cocfc.org)
- Center for Advancing the Teaching of Technology and Science (CATTS) [www.iteawww.org](http://www.iteawww.org)
- Center for Automotive Research and Intelligent Transportation [car.eng.ohio-state.edu](http://car.eng.ohio-state.edu)
- Division of Recycling and Litter Prevention, Ohio Department of Natural Resources [www.ohiodnr.com/recycling](http://www.ohiodnr.com/recycling)
- Division of Safety and Hygiene, Ohio Bureau of Workers Compensation [www.ohiobwc.com](http://www.ohiobwc.com)

# ACADEMIC CONTENT STANDARDS

- EE Ohio, The Center for Environmental Education in Ohio  
[www.environmentaleducationohio.org](http://www.environmentaleducationohio.org)
- Innovation Curriculum Online Network (ICON)  
[icontechlit.org](http://icontechlit.org)
- Junior Engineering Technical Society (JETS)  
[www.jets.org](http://www.jets.org)
- NASA Home Page  
[www.nasa.gov](http://www.nasa.gov)
- National Inventors Hall of Fame, Akron  
[www.invent.org/index.asp](http://www.invent.org/index.asp)
- National Institute for Environmental Health (NIEH)  
[www.niehs.nih.gov](http://www.niehs.nih.gov)
- National Science Digital Library (NSDL)  
[www.nsdll.org](http://www.nsdll.org)
- National STEM Digital Library, Science, Technology, Engineering and Mathematics  
[www.nsdll.nsf.gov/indexm.html](http://www.nsdll.nsf.gov/indexm.html)
- National Transportation Safety Board  
[www.nts.gov](http://www.nts.gov)
- Ohio Geographically Referenced Information (GIS) Program (OGRIP)  
[das.ohio.gov/itsd/ess/ogrip](http://das.ohio.gov/itsd/ess/ogrip)
- Ohio SchoolNet Commission (OSNC)  
[www.osn.state.oh.us](http://www.osn.state.oh.us)
- Office of Energy Efficiency and Renewable Energy  
[www.eere.energy.gov](http://www.eere.energy.gov)
- Office of Environmental Education, Ohio Environmental Protection Agency  
[www.epa.state.oh.us/oeef](http://www.epa.state.oh.us/oeef)
- TECH CORPS Ohio  
[www.techcorpsohio.org](http://www.techcorpsohio.org)

## *Instructional Resources*

Resources listed in this section are samples of teaching materials and resources to assist educators seeking practical and creative ways to implement standards-based instruction in technology and related benchmark topics.

## *Instructional Materials*

- 3D Body Scanner (ExploreCornell)  
[www.explore.cornell.edu/scene.cfm?scene=The%203d%20body%20scanner](http://www.explore.cornell.edu/scene.cfm?scene=The%203d%20body%20scanner)

# ACADEMIC CONTENT STANDARDS

- A World in Motion, Society of Automotive Engineers Foundation  
[www.sae.org/foundation/awim](http://www.sae.org/foundation/awim)
- American Memory, Historical Collections for the National Digital Library  
[memory.loc.gov](http://memory.loc.gov)
- Ancient Chinese Technology  
[library.thinkquest.org/23062/index.html](http://library.thinkquest.org/23062/index.html)
- Building Big  
[www.pbs.org/wgbh/buildingbig/index.html](http://www.pbs.org/wgbh/buildingbig/index.html)
- The Children Designing and Engineering Project  
[www.childrendesigning.org](http://www.childrendesigning.org)
- DESIGN (Doable Engineering Science Investigations Geared for Nonscience Students), Harvard - Smithsonian Center for Astrophysics  
[cfa-www.harvard.edu/cfa/sed/resources/designs.html](http://cfa-www.harvard.edu/cfa/sed/resources/designs.html)
- Discover Engineering.Org  
[www.discoverengineering.org/home.asp](http://www.discoverengineering.org/home.asp)
- Eisenhower National Clearinghouse for Mathematics and Science Education (ENC)  
[www.enc.org](http://www.enc.org)
- EngineerGirl  
[www.engineergirl.org](http://www.engineergirl.org)
- Ethics in Computing  
[www.eos.ncsu.edu/eos/info/computer\\_ethics](http://www.eos.ncsu.edu/eos/info/computer_ethics)
- FCC History of Technology Project  
[www.fcc.gov/omd/history](http://www.fcc.gov/omd/history)
- GIS ESRI Schools and Libraries Program  
[www.esri.com/industries/k-12](http://www.esri.com/industries/k-12)
- Go TECH  
[www.girlscouts.org/girlsgotech](http://www.girlscouts.org/girlsgotech)
- Great Achievements in Mechanical Engineering  
[www.asme.org/education/precollege/achieve/auto.htm](http://www.asme.org/education/precollege/achieve/auto.htm)
- Greatest Achievements of the 20th Century  
[www.greatachievements.org/greatachievements](http://www.greatachievements.org/greatachievements)
- History of Graphic Arts  
[teched.vt.edu/GCC/HTML/GCCKids/History.html](http://teched.vt.edu/GCC/HTML/GCCKids/History.html)
- Integrated Mathematics, Science, and Technology (IMAST - NSF), Center for Mathematics, Science, and Technology, Illinois State University  
[www.ilstu.edu/depts/cemast/imast/imasthome.htm](http://www.ilstu.edu/depts/cemast/imast/imasthome.htm)

# ACADEMIC CONTENT STANDARDS

- Invention Dimension, Massachusetts Institute of Technology  
[web.mit.edu/invent/invent-main.html](http://web.mit.edu/invent/invent-main.html)
- The Inventive Thinking Curriculum Project, U.S. Department of Commerce, Patent and Trademark Office  
[www.uspto.gov/web/offices/ac/ahrpa/opa/projxl/invthink/invthink.htm](http://www.uspto.gov/web/offices/ac/ahrpa/opa/projxl/invthink/invthink.htm)
- Learning by Design, The Edu Institute, Georgia Institute of Technology  
[www.cc.gatech.edu/projects/lbd/home.html](http://www.cc.gatech.edu/projects/lbd/home.html)
- NASA CORE (Central Operations of Resources for Educators)  
[core.nasa.gov](http://core.nasa.gov)
- NASA Classroom of the Future  
[www.cotf.edu](http://www.cotf.edu)
- NASA Education Home Page  
[education.nasa.gov](http://education.nasa.gov)
- NASA Education Enterprise  
[education.nasa.gov/home/index.html](http://education.nasa.gov/home/index.html)
- The NEED Project (National Energy Education Development)  
[www.need.org](http://www.need.org)
- Ohio Academy of Science, Heartland Sciences, Ohio's Legacy of Discovery and Innovation  
[www.heartlandscience.org](http://www.heartlandscience.org)
- Ohio Counties, 200 Years of Science and Technology  
[www.ohiosci.org/OHIOSCIENCE200.htm](http://www.ohiosci.org/OHIOSCIENCE200.htm)
- Ohio Resource Center for Mathematics, Science and Reading (ORC)  
[www.ohiorc.org](http://www.ohiorc.org)
- Project EXCITE  
[www.bgsu.edu/colleges/edhd/programs/excite](http://www.bgsu.edu/colleges/edhd/programs/excite)
- TECH-know Project  
[www.ncsu.edu/techknow/aboutproject.html](http://www.ncsu.edu/techknow/aboutproject.html)
- U.S. National Archives and Records Administration, Digital Classroom  
[www.archives.gov/digital\\_classroom/index.html](http://www.archives.gov/digital_classroom/index.html)

## *Program Experiences*

- Boosting Engineering, Science, and Technology (Best)  
[www.bestinc.org](http://www.bestinc.org)
- FIRST LEGO League  
[www.legomindstorms.com/fl1](http://www.legomindstorms.com/fl1)
- FIRST Robotics Competition  
[www.usfirst.org/robotics/index.html](http://www.usfirst.org/robotics/index.html)



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- Future City Competition, National Engineers Week  
[www.futurecity.org](http://www.futurecity.org)
- Future Problem-Solving Program  
[www.fpsp.org](http://www.fpsp.org)
- Future Scientists and Engineers of America (FSEA)  
[www.fsea.org](http://www.fsea.org)
- International Science and Engineering Fair, Junior Engineering Technical Society  
[www.sciserv.org/isef/index.asp](http://www.sciserv.org/isef/index.asp)
- International Student Media Festival  
[www.ismf.net](http://www.ismf.net)
- NASA Flight Design, NASA Student Involvement Program (NSIP)  
[education.nasa.gov/nsip](http://education.nasa.gov/nsip)
- National Engineering Design Challenge (NEDC)  
[www.jets.org/nedc.htm](http://www.jets.org/nedc.htm)
- National Engineers Week  
[www.eweek.org](http://www.eweek.org)
- NSTA Young Inventors Award  
[www.nsta.org/programs/craftsman](http://www.nsta.org/programs/craftsman)
- Project Lead the Way  
[www.pltw.org](http://www.pltw.org)
- TechXplore, National Science & Technology Partnership  
[www.nationalstep.org](http://www.nationalstep.org)