Technology Standards/Benchmarks

Level 3 - Grade Levels 6-8
Level 4 - Grade Levels 9-12

National Content Standards (TECHNOLOGY):

1. Knows the characteristics and uses of computer hardware and operating systems
2. Knows the characteristics and uses of computer software programs
3. Understands the relationships among science, technology, society, and the individual
4. Understands the nature of technological design
5. Understands the nature and operation of systems
6. Understands the nature and uses of different forms of technology

1. Knows the characteristics and uses of computer hardware and operating systems

Level 3 (Grade 6-8)
Benchmarks

1. Knows the differing capacities and trade-offs for computer storage media, such as CD-ROMs, floppy disks, hard disks, and tape drives

2. Types with some facility, demonstrating some memorization of keys

3. Connects via modem to other computer users via the internet, an on-line service, or bulletin board system

4. Knows basic characteristics and functions of an operating system

Level 4 (Grade 9-12)
Benchmarks

1. Knows of significant advances in computers and peripherals (e.g., data scanners, digital cameras)

2. Uses a variety of input devices (e.g., keyboard, scanner, voice/sound recorders, mouse, touch screen)

3. Knows limitations and trade-offs of various types of hardware (e.g., laptops, notebooks, modems)

4. Identifies malfunctions and problems in hardware (e.g., hard drive crash, monitor burn-out)

5. Knows features and uses of current and emerging technology related to computing (e.g., optical character recognition, sound processing, cable TV, cellular phones, ABS brakes)

2. Knows the characteristics and uses of computer software programs

Level 3 (Grade 6-8)
Benchmarks

1. Uses advanced features and utilities of word processors (e.g., uses clip art, a spell-checker, grammar checker, thesaurus, outliner)

2. Knows the common features and uses of desktop publishing software (e.g., documents are created, designed, and formatted for publication; data, graphics, and scanned images can be imported into a document using desktop software)

3. Knows the common features and uses of spreadsheets (e.g., data is entered in cells identified by row and column; formulas can be used to update solutions automatically; spreadsheets are used in print form, such as look-up tables, and electronic form, such as to track business profit and loss)

4. Uses a spreadsheet to update, add, and delete data, and to write and execute valid formulas on data

5. Uses boolean searches to execute complex searches on a data base

Level 4 (Grade 9-12)
Benchmarks

1. Understands the uses of listservs, usenet newsreaders, and bulletin board systems

2. Knows how to import, export, and merge data stored in different formats (e.g., text, graphics)

3. Knows how to import and export text, data, and graphics between software programs

4. Identifies some advanced features of software products (e.g., galleries, templates, macros, mail merge)

5. Uses desktop publishing software to create a variety of publications

3. Understands the relationships among science, technology, society, and the individual

Level 3 (Grade 6-8)
Benchmarks

1. Knows that scientific inquiry and technological design have similarities and differences (e.g., scientists propose explanations for questions about the natural world that are always tentative and evolving, and engineers propose solutions relating to human problems, needs, and aspirations; both science and technology depend on accurate scientific information and they cannot contravene scientific laws)

2. Knows that science cannot answer all questions and technology cannot solve all human problems or meet all human needs

3. Knows ways in which technology has influenced the course of history (e.g., revolutions in agriculture, manufacturing, sanitation, medicine, warfare, transportation, information processing, communication)

4. Knows that technology and science have a reciprocal relationship (e.g., technology drives science, as it provides the means to access outer space and remote locations, collect and treat samples, collect, measure, store, and compute data, and communicate information; science drives technology, as it provides principles for better instrumentation and techniques, and the means to address questions that demand more sophisticated instruments)

5. Knows ways in which technology and society influence one another (e.g., new products and processes for society are developed through technology; technological changes are often accompanied by social, political, and economic changes; technology is influenced by social needs, attitudes, values, and limitations, and cultural backgrounds and beliefs)

6. Knows examples of copyright violations and computer fraud (e.g., computer hacking, computer piracy, intentional virus setting, invasion of privacy) and possible penalties (e.g., large fines, jail sentences)

7. Knows ways technology is used to protect the environment and prevent damage caused by nature (e.g., new building technologies protect cities from earthquakes, bacteria are used in cleaning water)

Level 4 (Grade 9-12)
Benchmarks

1. Knows that science and technology are pursued for different purposes (e.g., scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans; technology is driven by the need to meet human needs and solve human problems)

2. Knows ways in which social and economic forces influence which technologies will be developed and used (e.g., cultural and personal values, consumer acceptance, patent laws, availability of risk capital, the federal budget, local and national regulations, media attention, economic competition, tax incentives)

3. Knows that alternatives, risks, costs, and benefits must be considered when deciding on proposals to introduce new technologies or to curtail existing ones (e.g., Are there alternative ways to achieve the same ends? Who benefits and who suffers? What are the financial and social costs and who bears them? How serious are the risks and who is in jeopardy? What resources will be needed and where will they come from?)

4. Knows that technological knowledge is often not made public because of patents and the financial potential of the idea or invention; scientific knowledge is made public through presentations at professional meetings and publications in scientific journals

5. Knows examples of advanced and emerging technologies (e.g., virtual environment, personal digital assistants, voice recognition software) and how they could impact society

6. Observes common courtesies and acceptable use policies while telecomputing

7. Knows that mathematics, creativity, logic, and originality are all needed to improve technology

8. Knows the role of technology in a variety of careers

9. Knows that the rate of technological development and diffusion is increasing rapidly, even though individual technologies may be developed at a slow pace due to technical difficulties or consumer resistance

10. Knows that technology can benefit the environment by providing scientific information, providing new solutions to older problems, and reducing the negative consequences of existing technology (e.g., monitoring a habitat or measuring greenhouse gases, improving renewable energy sources, and creating scrubbers to improve coal-burning facilities)

4. Understands the nature of technological design

Level 3 (Grade 6-8)
Benchmarks

1. Knows that the design process is a slow, methodical process of test and refinement

2. Knows that the design process relies on different strategies: creative brainstorming to establish many design solutions, evaluating the feasibility of various solutions in order to choose a design, and troubleshooting the selected design

3. Identifies appropriate problems which can be solved using technological design (e.g., identifies a specific need, considers its various aspects, considers criteria for a suitable product)

4. Designs a solution or product, taking into account needs and constraints (e.g., cost, time, trade-offs, properties of materials, safety, aesthetics)

5. Implements a proposed design (e.g., organizes materials and other resources, plans one's work, makes use of group collaboration when appropriate, chooses suitable tools and techniques, works with appropriate measurement methods to ensure accuracy)

6. Evaluates the ability of a technological design to meet criteria established in the original purpose (e.g., considers factors that might affect acceptability and suitability for intended users or beneficiaries; develop measures of quality with respect to these factors), suggests improvements, and tries proposed modifications

7. Understands that nonphysical objects (e.g., software) and physical objects (e.g., a telephone) are both subject to the design process

8. Knows that invention is the process of creating a new system or object out of an idea while innovation is the process of modifying an existing system or object to improve it (e.g., the specialization of function of a subsystem)

Level 4 (Grade 9-12)
Benchmarks

1. Knows that an optimal solution to a design problem is more likely to be found when the process followed is systematic and repetitive

2. Proposes designs and uses models, simulations, and other tests to choose an optimal solution

3. Implements a proposed solution (e.g., constructs artifacts for intended users or beneficiaries)

4. Evaluates a designed solution and its consequences based on the needs or criteria the solution was designed to meet

5. Knows that since there is no such thing as a perfect design, trade-offs of one criterion for another must occur to find an optimized solution

6. Knows that a design involves different design factors (e.g., ergonomics, maintenance and repair, environmental concerns) and design principles (e.g., flexibility, proportion, function)

5. Understands the nature and operation of systems

Level 3 (Grade 6-8)
Benchmarks

1. Knows that a system can include processes as well as components

2. Knows how part of a system can provide feedback when its output (in the form of material, energy, or information) becomes input for another part of the system

3. Identifies the elements, structure, sequence, operation, and control of systems

4. Assembles and disassembles systems to manage, control, and improve their performance (e.g., a computer program, a simple machine based on a pulley mechanism)

5. Knows that systems are usually linked to other systems, both internally and externally, and can contain subsystems as well as operate as subsystems

6. Knows that an open-loop system (e.g., a microwave as a heating system) has no feedback and requires human intervention, where a closed-loop system (e.g., a household heating system with a thermostat) uses feedback

Level 4 (Grade 9-12)
Benchmarks

1. Knows that a system usually has some properties that are different from those of its parts, but appear because of the interaction of those parts
2. Knows that understanding how things work and designing solutions to problems of almost any kind can be facilitated by systems thinking, which employs mathematical modeling and simulation

3. Knows that in defining a system, it is important to specify its boundaries and subsystems, indicate its relation to other systems, and identify what its input and its output are expected to be

4. Knows how feedback can be used to help monitor, control, and stabilize the operation of a system

5. Knows that complex systems are subject to failure and are designed with various elements and procedures (e.g., performance testing, overdesign, redundancy, more controls) that help reduce system failure

6. Knows that even in simple systems, accurate prediction of the effect of changing some part of the system is not always possible

7. Constructs and operates systems (e.g., organizes and adjusts subsystems)

8. Knows that systems are embedded within larger systems, including technological, social, and environmental systems

6. Understands the nature and uses of different forms of technology

Level 3 (Grade 6-8)
Benchmarks

1. Understands ways in which medical technology improves the quality of health care (e.g., advanced diagnosing equipment, increased hospital sanitation)

2. Knows ways in which biotechnology results in benefits for humans, including more convenience, less labor, improved health and medicine, and improved food

3. Knows that most technological systems require an input of energy, which is an important consideration both in designing an object or a system and in conserving energy (e.g., so many things require energy that alternative sources to fossil fuels should be used when possible)

4. Knows the components of a communication system (i.e., a source, encoder, transmitter, receiver, decoder, and destination)

5. Knows that individual transportation vehicles contain several subsystems (e.g., structural, propulsion, control)

6. Knows that manufacturing processes use hand tools, human-operated machines, and automated machines to separate, form, combine, and condition natural and synthetic materials; these changes may either be physical or chemical

7. Knows that construction design is influenced by factors such as building laws and codes, style, convenience, cost, climate, and function

Level 4 (Grade 9-12)
Benchmarks

1. Knows that genetic engineering is the process by which controlled changes in a genetic structure can be made and that this process is used to research and diagnose disease and create pharmaceuticals

2. Knows that biotechnology is used in a variety of areas (e.g., agriculture, pharmaceuticals, food and beverage, fuels and energy, the environment, genetic engineering) and requires specific scientific knowledge about the natural system being modified

3. Understands scientific principles of energy, work, and power in relation to technological design (e.g., the Second Law of Thermodynamics means that a system cannot be designed which is 100% efficient)

4. Knows that power systems (i.e., systems which convert energy from one form to another) have a source of energy, a process, loads, and some have a feedback system

5. Knows that communication systems can transfer information from person to person (e.g., a telephone), person to machine (e.g., a person inputting information into a computer), or machine to machine (e.g., an automated payroll system where the record of the money goes from one computer to another)

6. Knows that modern transportation systems are diverse (allowing humans to combine types of transportation for the most direct and convenient route), intelligent (requiring coordinated subsystems, such as a traffic light system), and are necessary in the functioning of most other technologies

7. Knows that there are different types of manufacturing systems (customized, batch, and continuous production) and manufacturing results in two different types of goods, durable and non-durable

8. Knows different requirements for structural design (e.g., strength, maintenance, appearance) and that these structures require maintenance