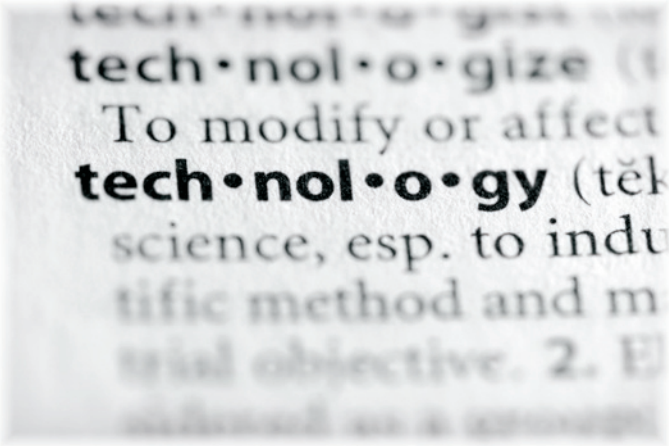
Identify Competencies for Technological Literacy

IN THIS UNIT, a series of 20 standards review specific issues in technology required to achieve technological literacy. The standards range from defining technology to its effects, how it is developed, and how it is used.

Also, reading skills can be developed through learning and using technical terms. Writing skills can also be developed by using technical vocabulary in writing. To be technologically literate means that you understand and can use the terms properly. Each industry or career field has its own specialized vocabulary.



Objectives:

1. Demonstrate knowledge of standards for technological literacy.
2. Demonstrate reading skills through technical vocabulary acquisition.
3. Demonstrate acquisition of a technical vocabulary and use that vocabulary in writing.

Key Terms:

assessment techniques
biotechnology
conservation
design process
ecosystems
forecasting techniques
infrastructure
intermodalism
marketing
problem solving
profit motive
prototype
research and development
systems
technological literacy
technology
technology transfer

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Standards for Technological Literacy

STANDARD 1

FIGURE 1. Goal-directed research may lead to innovation.

Develop an understanding of the characteristics and scope of technology.

The nature and development of technological knowledge and processes are a function of the setting. The rate of technological development and diffusion is increasing rapidly. Inventions and innovation are the result of specific, goal-directed research. Most modern technologies are driven by the profit motive and by the market. The **profit motive** is how much money can be made from the new technology.

STANDARD 2

Develop an understanding of the core concepts of technology.

Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems. **Systems**, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems. The stability of a technological system is influenced by all of the system components, especially those in the feedback loop. Selecting resources involves trade-offs between competing values (e.g., availability, cost, desirability, and waste).

Requirements involve criteria identification and product or system constraints. They must provide a demonstration of how they affect the final design and development. Optimization is an ongoing process or methodology of designing or making a product, which is dependent on various criteria and constraints. Yet new technologies create new processes.

Quality control is a planned process to ensure that a product, service, or system meets established criteria. Management is the process of planning, organizing, and controlling work. Complex systems have many layers of control and feedback loops to provide information.

STANDARD 3

Develop an understanding of the relationships among technologies and the connection between technology and other fields of study.

Technology transfer occurs when a new user applies an existing innovation—developed for one purpose—to a new and different function. Technological innovation often results when ideas, knowledge, or skills are shared within a technology. It can also occur when shared

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among other technologies within its field or across other fields. Technological ideas are sometimes protected through patenting. Technological progress promotes the advancement of science and mathematics.

STANDARD 4

Develop an understanding of the cultural, social, economic, and political effects of technology.

Changes caused by technology use can range from gradual to rapid and from subtle to obvious. Making decisions about technology use involves weighing the positive and negative effects. Ethical considerations are important in the development, selection, and use of technologies. The transfer of technology from one society to another can cause cultural, social, economic, and political changes that affect both societies in varying degrees.

FIGURE 2. Scanning a card instead of using a traditional key is a modern development.

STANDARD 5

Develop an understanding of the effects of technology on the environment.

Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling. When new technologies are developed to reduce the use of natural resources, considerations of trade-offs are important. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment. Humans devise technologies to reduce the negative consequences of other technologies. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.

FIGURE 3. The impact of technological advances should be analyzed.

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STANDARD 6

Develop an understanding of the role of society in the development and use of technology.

Different cultures develop their technologies to satisfy their individual and shared needs, wants, and values. The decision to develop a technology is influenced by a society's opinions and demands. It is also influenced by corporate cultures. A number of different factors contribute to shaping the design and demand for various technologies (e.g., advertising, the strength of the economy, the goals of a company, and the latest fads).

STANDARD 7

Develop an understanding of the influence of technology on history.

Most technological development has been evolutionary. It has been the result of a series of refinements to a basic invention. The evolution of civilization has been directly affected by new tools and materials from technological advances. In addition, the development and use of tools and materials has been directly affected by the evolution of civilization. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.

Early in the history of technology, the development of many tools and machines was based on technical know-how. Now it is based more on scientific know-how. The Iron Age was defined by the use of iron and steel as the primary materials for tools. The Middle Ages saw the development of many technological devices that produced long-lasting effects on technology and society. The Renaissance was a time of rebirth for the arts and humanities that also saw many important developments in the history of technology. Many of these allowed the study of our world in detail and developed much scientific knowledge. The Industrial Revolution involved the development of continuous manufacturing and the addition of sophisticated transportation and communication systems. It developed advanced construction practices, improved education, and gave us more leisure time. The Information Age places emphasis on the processing and exchanging of digital information through electronics.

STANDARD 8

Develop an understanding of the attributes of design.

The **design process** includes defining a problem, brainstorming, researching, and generating ideas. It includes identifying criteria, specifying constraints, exploring possibilities, and selecting an approach. It also involves making a model or prototype, testing and evaluating the design by using specifications, refining the design, and testing it. Then it is necessary to communicate the processes and results.

Design problems are seldom presented in a clearly defined form. Typically, a desired result is the goal. The exact way to achieve it is not certain. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. Requirements of a design (e.g., criteria, constraints, and efficiency) sometimes compete.

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STANDARD 9

Develop an understanding of engineering design.

The process of engineering design takes into account a number of factors. Established design principles are used to evaluate existing designs. They are used to collect relevant data and to guide the design process. Engineering design is influenced by personal characteristics (e.g., creativity, resourcefulness, and the ability to visualize and think abstractly). A prototype is almost always created in engineering design. It is used to study, test, and analyze the design. A **prototype** is a working model used to test a design concept. Adjustments can be made and observed with the creation of a model.

FIGURE 4. A prototype is used to test a design concept.

STANDARD 10

Develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Problem solving is the ability to use everything at your disposal to creatively solve a problem. **Research and development** is a specific problem-solving approach used intensively in business and industry to prepare devices and systems for the marketplace. Technological problems must be researched before they can be solved. Not all the problems are technological, and not every problem can be solved using technology. Many technological problems require a multidisciplinary approach. Therefore, several people from different areas of study work together to solve the problem.

STANDARD 11

Develop abilities to apply the design process.

In the design process, you first need to identify the design problem. Then you must determine if you should address the problem. Criteria and constraints need to be identified, and you need to determine how these will affect the design process. A design needs to be refined by using prototypes and modeling to ensure the desired results (e.g., quality, efficiency, and productivity of the final product). The design solutions must be evaluated by using conceptual, physical, and mathematical models at various intervals of the design process. This is done to check for proper design and to note areas where improvements are needed. You must evaluate final solutions and then communicate observations, processes, and results of the entire design

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process. This is done using verbal, graphic, quantitative, virtual, and written means. It can also include three-dimensional models.

STANDARD 12

Develop abilities to use and maintain technological products and systems.

This is achieved through the documenting processes and procedures and through communicating the processes to different audiences via appropriate oral and written techniques. A malfunctioning system must be diagnosed. Then tools, materials, machines, and knowledge must be used to repair it. It is essential to troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision. This includes the operation of systems so they function in the way they were designed. Computers and calculators are needed to access, retrieve, organize, process, maintain, interpret, and evaluate data and information to communicate.

STANDARD 13

Develop abilities to assess the impact of products and systems.

This is achieved through the collection of information, the evaluation of its quality, the synthesizing of data, the analyzing of trends, and the drawing of conclusions regarding the effects of technology on the individual, society, and the environment. This can also be achieved by using **assessment techniques**, such as trend analysis and experimentation. These can aid in making decisions about the future development of technology. Design **forecasting techniques** are used to evaluate the results of altering natural systems, which can be useful in assessing the impact of new products and systems.

STANDARD 14

Develop an understanding of and be able to select and use medical technologies.

Medical technologies include prevention and rehabilitation. They also include vaccines and pharmaceuticals, medical and surgical procedures, and genetic engineering. Basically any aspect of the systems used to protect and maintain health care is part of medical technologies. Telemedicine reflects the convergence of technological advances in fields related to medicine and telecommunications. This can include virtual presence, computer engineering, informatics, artificial intelligence, robotics, materials science, and perceptual psychology. In addition, biochemistry and molecular biology have made it possible to manipulate the genetic information found on living creatures.

STANDARD 15

Develop an understanding of and be able to select and use agricultural biotechnologies and related biotechnologies.

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Agriculture includes a combination of businesses that use a wide array of products and systems. They are used to produce, process, and distribute food, fiber, fuel, chemicals, and other useful products. **Biotechnology** has applications in such areas as agriculture, food, and beverages. It also has applications in medicine, pharmaceuticals, energy, the environment, and genetic engineering. **Conservation** is the process of controlling human effects on the environment. It includes controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality. The engineering design management of agricultural systems requires knowledge of artificial **ecosystems**, which are areas created or altered through agricultural management. In general, it requires looking at all the effects of technological development on flora and fauna.

FIGURE 5. The effects of technological advances must be studied.

STANDARD 16

Develop an understanding of and be able to select and use energy and power technologies.

Energy cannot be created or destroyed. However, it can be converted from one form to another. Energy can be grouped into the following major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others. It is impossible to build an engine to perform work that does not exhaust thermal energy to its surroundings. Energy resources can be renewable or nonrenewable. Power systems must have a source of energy, a process, and loads. They all convert one form of energy into another.

STANDARD 17

Develop an understanding of and be able to select and use information and communication technologies.

Information and communication technologies include the inputs, processes, and outputs associated with sending and receiving information. These systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate. They are made up of a source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination devices. There are many ways to communicate information (e.g., graphic and electronic means). Technological knowledge and processes are communicated using symbols, measurements, conventions, and icons. They are also communicated with graphic images and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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STANDARD 18

Develop an understanding of and be able to select and use transportation technologies.

Transportation plays a vital role in the operation of other technologies: manufacturing, construction, communication, health and safety, and agriculture. Transportation services and methods have led to a population that is regularly on the move. **Intermodalism** is the use of different modes of transportation (e.g., highways, railways, and waterways) as part of an interconnected system that can move people and goods easily from one mode to another.

STANDARD 19

Develop an understanding of and be able to select and use manufacturing technologies.

Servicing keeps products in good operating condition, which is important in manufacturing technologies. Durable goods are designed to operate for a long period of time. Maintenance can be part of a scheduled system and design feature. However, nondurable goods are designed to operate for only a short period. Manufacturing systems may be classified into types (e.g., customized production, batch production, and continuous production). The interchangeability of parts increases the effectiveness of manufacturing processes. Materials have different qualities and may be classified as natural, synthetic, or mixed. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products. **Marketing** involves establishing a product's identity, conducting research on its potential, advertising it, distributing it, and selling it.

STANDARD 20

Develop an understanding of and be able to select and use construction technologies.

Structures are constructed using a variety of processes and procedures. The design of structures includes a number of requirements. Structures require maintenance, alterations, and renovations periodically to improve them or to alter their intended use. Structures can also include prefabricated materials. **Infrastructure** is the underlying base or basic framework of a system.

Reading Skills

In demonstrating reading skills through technical vocabulary acquisition, you must be aware of some basic elements. **Technology** is the process by which humans modify their surroundings. It involves the application of scientific principles. Technological literacy implies that people have the tools to understand technical applications. Technical terms may be general, in which case they may be used in many applications of technology. They include terms from science to mathematics. Also, many technical terms are specific to each application in technology.

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Acquisition of a Technical Vocabulary

To demonstrate acquisition of a technical vocabulary by using that vocabulary in writing, basic elements must be known. For instance, each industry or career field has its own specialized vocabulary. Some of these include industrial fields (e.g., manufacturing, construction, and computer technology). **Technological literacy** means a person understands the meanings of technological terms and can use the terms correctly.

Summary:

The 20 standards are required to achieve technological literacy. The standards include knowing the definition of technology as well as comprehending how it affects us, society, and the environment. The standards also include how technology is developed and used in various fields.

Learning and using technical terms can help develop reading skills. Technical terms can vary in their meaning, depending on the particular use or field. Some are general and some may be specific in each application in technology.

Learning and using technical terms in writing can also help develop your writing skills. If you can understand and use the terms, you are technically literate. There are some specialized terms that exist in each specific industry and technological field.

Checking Your Knowledge:

1. What is profit motive?
2. When does technology transfer occur?
3. Name four steps in the design process.
4. What is a multidisciplinary approach?
5. Name three areas where biotechnology is applied.

Expanding Your Knowledge:

To help in learning all this information, create a list with the 20 standards. Under each topic, list specific applications or relationships in your life.

Web Links:

Research and Innovative Technology Administration
http://www.rita.dot.gov/

The Society for the History of Technology
http://www.historyoftechnology.org/index.html

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