

Project Lead the Way®: Biotechnical Engineering™

Standards for Technological Literacy

<p>Key:</p> <p>√ denotes a correlation in ideas and concepts in both standards and lessons.</p> <p>x denotes the ideas and concepts may not be directly addressed, but the ideas are supported in both lessons and activities</p> <p>• denotes an implied idea or concept that may be used in both lesson and activity</p>	Unit 1 Safety & Document Review	Unit 2 Introduction to Biotechnical Engineering	Unit 3 Biochemical Engineering	Unit 4 Environmental & Agricultural Engineering	Unit 5 Biomedical Engineering
<p>STL Standard 1: Students will develop an understanding of the characteristics and scope of technology.</p>					
<p>J. The nature and development of technological knowledge and processes are functions of the setting.</p>		x	x	x	x
<p>K. The rate of technological development and diffusion is increasing rapidly.</p>		x	x	x	x
<p>L. Inventions and innovations are the results of specific, goal-directed</p>		x	x	x	x
<p>STL Standard 2: Students will develop an understanding of the core concepts of technology.</p>					
<p>W. Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.</p>			√	√	√

<p>X. Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems.</p>		<p>x</p>	<p>x</p>	<p>x</p>	<p>x</p>
<p>Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.</p>		<p>√</p>	<p>x</p>	<p>x</p>	<p>x</p>
<p>AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.</p>			<p>√</p>	<p>√</p>	<p>√</p>
<p>BB. Optimization is an on going process or methodology of designing or making a product and is dependent on criteria and constraints.</p>			<p>√</p>	<p>√</p>	<p>√</p>
<p>CC. New technologies create new processes.</p>		<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>
<p>EE. Management is the process of planning, organizing, and controlling work.</p>		<p>x</p>	<p>x</p>	<p>x</p>	<p>x</p>
<p>STL Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.</p>		<p>x</p>	<p>x</p>	<p>x</p>	<p>x</p>

<p>H. Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.</p>		√			
<p>I. Technological ideas are sometimes protected through the process of patenting. The protection of a creative idea is central to the sharing of technological knowledge.</p>	x				
<p>J. Technological progress promotes the advancement of science and mathematics. Likewise, progress in science and mathematics leads to advances in technology.</p>		√			
<p>STL Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.</p>					
<p>H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious.</p>		√	x	x	x
<p>I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.</p>	√		√	√	√
<p>J. Ethical considerations are important in the development, selection, and use of technologies.</p>		√	√	√	√

	K. The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.		x	x	x	x
STL Standard 5: Students will develop an understanding of the effects of technology on the environment.						
K-2	A. Some materials can be reused and/or recycled.					
	G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.		√		x	
	H. When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.				√	
	I. With the aid of technology, various aspects of the environment can be monitored to provide information for decision-making.				√	
	J. The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment.				√	
	K. Humans devise technologies to reduce the negative consequences of other technologies.			√	√	√

L. Decisions regarding the implementation of technologies involve the weighing of tradeoffs between predicted positive and negative effects on the environment.			√	√	√
STL Standard 6: Students will develop an understanding of the role of society in the development and use of technology.					
H. Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values.		x			
I. The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.		x		x	x
J. A number of different factors, such as advertising, the strength of the economy, the goals of a company and the latest fads contribute to shaping the design of and demand for various technologies.			x		
STL Standard 7: Students will develop an understanding of the influence of technology on history.					
G. Most technological development has been evolutionary, the result of a series of refinements to a basic invention.			√	x	x
				x	x

<p>H. The evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials.</p>		√	•	•	•
<p>I. Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape.</p>		√			
<p>J. Early in the history of technology, the development of many tools and machines was based not on scientific knowledge but on technological know-how.</p>		√			
<p>K. The Iron Age was defined by the use of iron and steel as the primary materials for tools.</p>		x			
<p>L. The Middle Ages saw the development of many technological devices that produced long-lasting effects on technology and society.</p>		x			
<p>M. The Renaissance, a time of rebirth of the arts and humanities, was also an important development in the history of technology.</p>		x			

<p>N. The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation, and communication systems, advanced construction practices, and improved education and leisure time.</p>		<p>x</p>			
<p>O. The Information Age places emphasis on the processing and exchange of information.</p>		<p>x</p>			
<p>STL Standard 8: Students will develop an understanding of the attributes of design.</p>					
<p>H. The design process includes 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, and communicating processes and results.</p>	<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>
<p>I. Design problems are seldom presented in a clearly defined form.</p>	<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>

<p>J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.</p>	√	√	√	√	√
<p>K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.</p>	√	√	√	√	√
<p>STL Standard 9: Students will develop an understanding of engineering design.</p>					
<p>I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.</p>		x	x	x	x
<p>J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.</p>		x	x	x	x
<p>K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.</p>	x	x	√	√	√
<p>L. The process of engineering design takes into account a number of factors.</p>	x	x	√	√	√
<p>STL Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and</p>					

<p>I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.</p>		<p>x</p>	<p>x</p>	<p>x</p>	<p>x</p>
<p>J. Technological problems must be researched before they can be solved.</p>		<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>
<p>K. Not all problems are technological, and not every problem can be solved using technology.</p>		<p>x</p>	<p>x</p>	<p>x</p>	<p>x</p>
<p>L. Many technological problems require a multidisciplinary approach.</p>		<p>x</p>	<p>x</p>	<p>x</p>	<p>x</p>
<p>STL Standard 11: Students will develop the abilities to apply the design process.</p>					
<p>M. Identify the design problem to solve and decide whether or not to address it.</p>			<p>√</p>	<p>√</p>	<p>√</p>
<p>N. Identify criteria and constraints and determine how these will affect the design process.</p>			<p>√</p>	<p>√</p>	<p>√</p>
<p>O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.</p>			<p>√</p>	<p>√</p>	<p>√</p>

<p>P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed.</p>			√	√	√
<p>Q. Develop and produce a product or system using a design process.</p>			x	√	√
<p>R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.</p>			√	√	√
<p>STL Standard 12: Students will develop the abilities to use and maintain technological products and systems.</p>					
<p>L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.</p>	√		√	√	√
<p>M. Diagnose a system that is malfunctioning and use tools, materials, machines, and knowledge to repair it.</p>			x	x	x
<p>N. Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision.</p>	√		x	x	√

<p>O. Operate systems so that they function in the way they were designed.</p>			<p>x</p>	<p>x</p>	<p>√</p>
<p>P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.</p>	<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>
<p>STL Standard 13: Students will develop the abilities to assess the impact of products and systems.</p>					
<p>J. Collect information and evaluate its quality.</p>	<p>√</p>		<p>√</p>	<p>√</p>	<p>√</p>
<p>K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.</p>		<p>√</p>	<p>√</p>	<p>√</p>	<p>√</p>
<p>L. Use assessment techniques, such as trend analysis and experimentation to make decisions about the future development of technology.</p>		<p>x</p>	<p>x</p>	<p>√</p>	<p>√</p>
<p>M. Design forecasting to evaluate the results of altering natural systems.</p>				<p>•</p>	
<p>STL Standard 14: Students will develop an understanding of and be able to select and use medical technologies.</p>					

<p>K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.</p>		√		•	√
<p>L. 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.</p>		•	•	•	•
<p>M. The sciences of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.</p>		√	x	x	
<p>STL Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.</p>					
<p>K. Agriculture includes a combination of businesses that use a wide array of products and systems to produce, process, and distribute food, fiber, fuel, chemical, and other useful products.</p>		√		√	

<p>L. Biotechnology has applications in such areas as agriculture, pharmaceuticals, food and beverages, medicine, energy, the environment, and genetic engineering.</p>		√	√	√	√
<p>M. Conservation is the process of controlling soil erosion, reducing sediment in waterways, conserving water, and improving water quality.</p>				x	
<p>N. The engineering design and management of agricultural systems require knowledge of artificial ecosystems and the effects of technological development on flora and fauna.</p>				x	
<p>STL Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.</p>					
<p>J. Energy cannot be created or destroyed; however, it can be converted from one form to another.</p>				x	
<p>K. Energy can be grouped into major forms: thermal, radiant, electrical, mechanical, chemical, nuclear, and others.</p>				•	
<p>L. It is possible to build an engine to perform work that does not exhaust thermal energy to the surroundings.</p>				•	
<p>M. Energy resources can be renewable or nonrenewable.</p>				•	

<p>STL Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.</p>					
<p>M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.</p>	•	•			
<p>N. Information and communication systems can be used to inform, persuade, entertain, control, manage, and educate.</p>		•	•	•	•
<p>O. Communication systems are made up of source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.</p>					
<p>P. There are many ways to communicate information, such as graphic and electronic means.</p>	•	•	•	•	•
<p>Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.</p>		•	•	•	•
<p>STL Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.</p>					

STL Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.					
M. Materials have different qualities and may be classified as natural, synthetic, or mixed.				x	x
Q. Chemical technologies provide a means for humans to alter or modify materials and to produce chemical products.				.	
R. Marketing involves establishing a product's identity, conducting research on its potential, advertising it, distributing it, and selling it.				.	.

Table 1. Comparison of *Standards for Technological Literacy (STL)* and Project Lead The Way® Biotechnical Engineering™.

[Source: International Technology Education Association's \(ITEA\) Standards for Technological Literacy: Content for the Study of Technology.](#)