Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education

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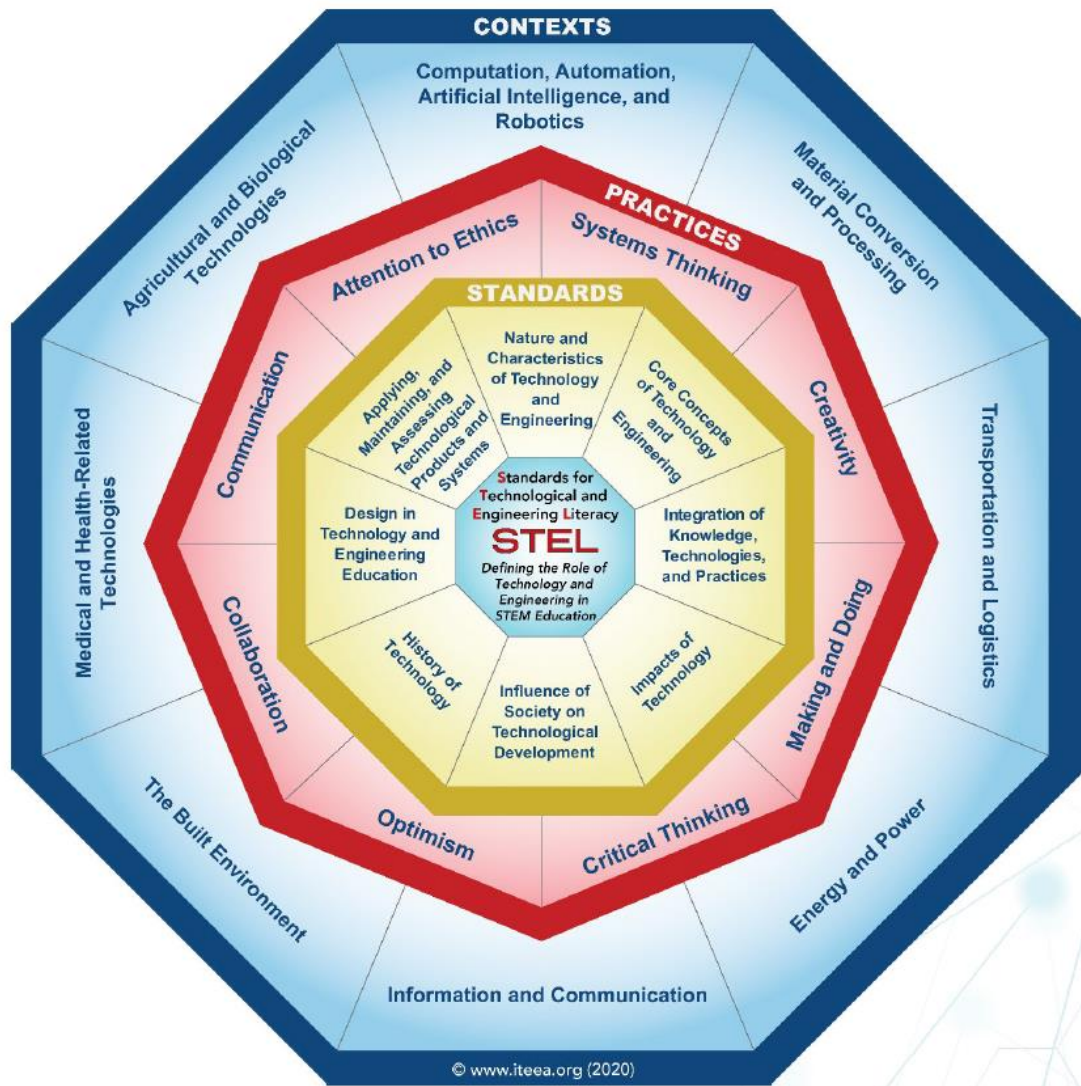
Standard 1: Nature and Characteristics of Technology and Engineering

Grades PreK-2
A. Compare the natural world and human-made world.
B. Explain the tools and techniques that people use to help them do things.
C. Demonstrate that creating can be done by anyone.
D. Discuss the roles of scientists, engineers, technologists, and others who work with technology

Grades 3-5
E. Compare how things found in nature differ from things that are human-made, noting differences and similarities in how they are produced and used.
F. Describe the unique relationship between science and technology, and how the natural world can contribute to the humanmade world to foster innovation.
G. Differentiate between the roles of scientists, engineers, technologists, and others in creating and maintaining technological systems.
H. Design solutions by safely using tools, materials, and skills.
I. Explain how solutions to problems are shaped by economic, political, and cultural forces.

Grades 6-8
J. Develop innovative products and systems that solve problems and extend capabilities based on collective needs and wants
K. Compare and contrast the contributions of science, engineering, mathematics, and technology in the development of technological systems.

L. Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.
M. Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches

Grades 9-12
N. Explain how the world around them guides technological development and engineering design
O. Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.
P. Analyze the rate of technological development and predict future diffusion and adoption of new technologies.
Q. Conduct research to inform intentional inventions and innovations that address specific needs and wants.
R. Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.

Standard 2: Core Concepts of Technology and Engineering

Grades PreK-2
A. Illustrate how systems have parts or components that work together to accomplish a goal.
B. Safely use tools to complete tasks.
C. Explain that materials are selected for use because they possess desirable properties and characteristics.
D. Develop a plan in order to complete a task.
E. Collaborate effectively as a member of a team.

Grades 3-5
F. Describe how a subsystem is a system that operates as part of another, larger system.
G. Illustrate how, when parts of a system are missing, it may not work as planned.
H. Identify the resources needed to get a technical job done, such as people, materials, capital, tools, machines, knowledge, energy, and time.
I. Describe the properties of different materials.
J. Demonstrate how tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.
K. Describe requirements of designing or making a product or system.
L. Create a new product that improves someone's life.

Grades 6-8
M. Differentiate between inputs, processes, outputs, and feedback in technological systems.
N. Illustrate how systems thinking involves considering relationships between every part, as well as how the system interacts with the environment in which it is used.
O. Create an open-loop system that has no feedback path and requires human intervention.
P. Create a closed-loop system that has a feedback path and requires no human intervention.
Q. Predict outcomes of a future product or system at the beginning of the design process.
R. Compare how different technologies involve different sets of processes.
S. Defend decisions related to a design problem.

Grades 9-12
T. Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.
U. Diagnose a flawed system embedded within a larger technological, social, or environmental system.
V. Analyze the stability of a technological system and how it is influenced by all the components in the system, especially those in the feedback loop.
W. Select resources that involve tradeoffs between competing values, such as availability, cost, desirability, and waste, while solving problems.
X. Cite examples of the criteria and constraints of a product or system and how they affect final design.
Y. Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.
Z. Use management processes in planning, organizing, and controlling work.

Standard 3: Integration of Knowledge, Technologies, and Practices

Grades PreK-2
A. Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple content areas.
B. Draw connections between technology and human experiences.

Grades 3-5

C. Demonstrate how simple technologies are often combined to form more complex systems.
D. Explain how various relationships can exist between technology and engineering and other content areas.

Grades 6-8

E. Analyze how different technological systems often interact with economic, environmental, and social systems.
F. Apply a product, system, or process developed for one setting to another setting.
G. Explain how knowledge gained from other content areas affects the development of technological products and systems.

Grades 9-12

H. Analyze how technology transfer occurs when a user applies an existing innovation developed for one function to a different purpose.
I. Evaluate how technology enhances opportunities for new products and services through globalization.
J. Connect technological progress to the advancement of other areas of knowledge, and vice versa.

Standard 4: Standard 2: Impacts of Technology

Grades PreK-2

A. Explain ways that technology helps with everyday tasks.
B. Illustrate helpful and harmful effects of technology.
C. Compare simple technologies to evaluate their impacts.
D. Select ways to reduce, reuse, and recycle resources in daily life.
E. Design new technologies that could improve their daily lives.

Grades 3-5

F. Describe the helpful and harmful effects of technology.
G. Judge technologies to determine the best one to use to complete a given task or meet a need.
H. Classify resources used to create technologies as either renewable or non-renewable.
I. Explain why responsible use of technology requires sustainable management of resources.
J. Predict how certain aspects of their daily lives would be different without given technologies.

Grades 6-8

K. Examine the ways that technology can have both positive and negative effects at the same time.
L. Analyze how the creation and use of technologies consumes renewable and non-renewable resources and creates waste.
M. Devise strategies for reducing, reusing, and recycling waste caused from the creation and use of technology.
N. Analyze examples of technologies that have changed the way people think, interact, and communicate.
O. Hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected.

Grades 9-12

P. Evaluate ways that technology can impact individuals, society, and the environment.
Q. Critique whether existing and proposed technologies use resources sustainably.
R. Assess a technology that minimizes resource use and resulting waste to achieve a goal.
S. Develop a solution to a technological problem that has the least negative environmental and social impact.
T. Evaluate how technologies alter human health and capabilities.

Standard 5: Influence of Society on Technological Development

Grades PreK-2

A. Explain the needs and wants of individuals and societies.
B. Explore how technologies are developed to meet individual and societal needs and wants.
C. Investigate the use of technologies in the home and community.

Grades 3-5

D. Determine factors that influence changes in a society's technological systems or infrastructure.
E. Explain how technologies are developed or adapted when individual or societal needs and wants change.

Grades 6-8

F. Analyze how an invention or innovation was influenced by its historical context.
G. Evaluate trade-offs based on various perspectives as part of a decision process that recognizes the need for careful compromises among competing factors.

Grades 9-12
H. Evaluate a technological innovation that arose from a specific society's unique need or want.
I. Evaluate a technological innovation that was met with societal resistance, impacting its development.
J. Design an appropriate technology for use in a different culture.

Standard 6: History of Technology

Grades PreK-2
A. Discuss how the way people live and work has changed throughout history because of technology.

Grades 3-5
B. Create representations of the tools people made, how they cultivated food, made clothing, and built shelters to protect themselves.

Grades 6-8
C. Compare various technologies and how they have contributed to human progress.
D. Engage in a research and development process to simulate how inventions and innovations have evolved through systematic tests and refinements.
E. Verify how specialization of function has been at the heart of many technological improvements.

Grades 9-12
F. Relate how technological development has been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.
G. Verify that the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.
H. Evaluate how technology has been a powerful force in reshaping social, cultural, political, and economic landscapes throughout history.
I. Analyze how the Industrial Revolution resulted in the development of mass production, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.
J. Investigate the widespread changes that have resulted from the Information Age, which has placed emphasis on the processing and exchange of information.

Standard 7: Design in Technology and Engineering Education

Grades PreK-2
A. Apply design concepts, principles, and processes through play and exploration.
B. Demonstrate that designs have requirements.
C. Explain that design is a response to wants and needs.
D. Discuss that all designs have different characteristics that can be described.
E. Illustrate that there are different solutions to a design and that none are perfect.
F. Differentiate essential skills of the technology and engineering design process.
G. Apply skills necessary for making in design.

Grades 3-5
H. Illustrate that there are multiple approaches to design.
I. Apply the technology and engineering design process.
J. Evaluate designs based on criteria, constraints, and standards.
K. Interpret how good design improves the human condition.
L. Apply universal principles and elements of design.
M. Evaluate the strengths and weaknesses of existing design solutions, including their own solutions.
N. Practice successful design skills.
O. Apply tools, techniques, and materials in a safe manner as part of the design process.

Grades 6-8
P. Illustrate the benefits and opportunities associated with different approaches to design.
Q. Apply the technology and engineering design process.
R. Refine design solutions to address criteria and constraints.
S. Create solutions to problems by identifying and applying human factors in design.
T. Assess design quality based upon established principles and elements of design.
U. Evaluate the strengths and weaknesses of different design solutions.
V. Improve essential skills necessary to successfully design.

Grades 9-12
W. Determine the best approach by evaluating the purpose of the design.
X. Document trade-offs in the technology and engineering design process to produce the optimal design.
Y. Optimize a design by addressing desired qualities within criteria and constraints.
Z. Apply principles of human-centered design.
AA. Illustrate principles, elements, and factors of design.
BB. Implement the best possible solution to a design.
CC. Apply a broad range of design skills to their design process.
DD. Apply a broad range of making skills to their design process.

Standard 8: Applying, Maintaining, and Assessing Technological Products and Systems

Grades PreK-2
A. Analyze how things work.
B. Identify and use everyday symbols
C. Describe qualities of everyday products.

Grades 3-5
D. Follow directions to complete a technological task.
E. Use appropriate symbols, numbers, and words to communicate key ideas about technological products and systems.
F. Identify why a product or system is not working properly.
G. Examine information to assess the trade-offs of using a product or system.

Grades 6-8
H. Research information from various sources to use and maintain technological products or systems.
I. Use tools, materials, and machines to safely diagnose, adjust, and repair systems.
J. Use devices to control technological systems.
K. Design methods to gather data about technological systems.
L. Interpret the accuracy of information collected.
M. Use instruments to gather data on the performance of everyday products.

Grades 9-12
N. Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.
O. Develop a device or system for the marketplace.
P. Apply appropriate methods to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.
Q. Synthesize data and analyze trends to make decisions about technological products, systems, or processes.
R. Interpret the results of technology assessment to guide policy development.