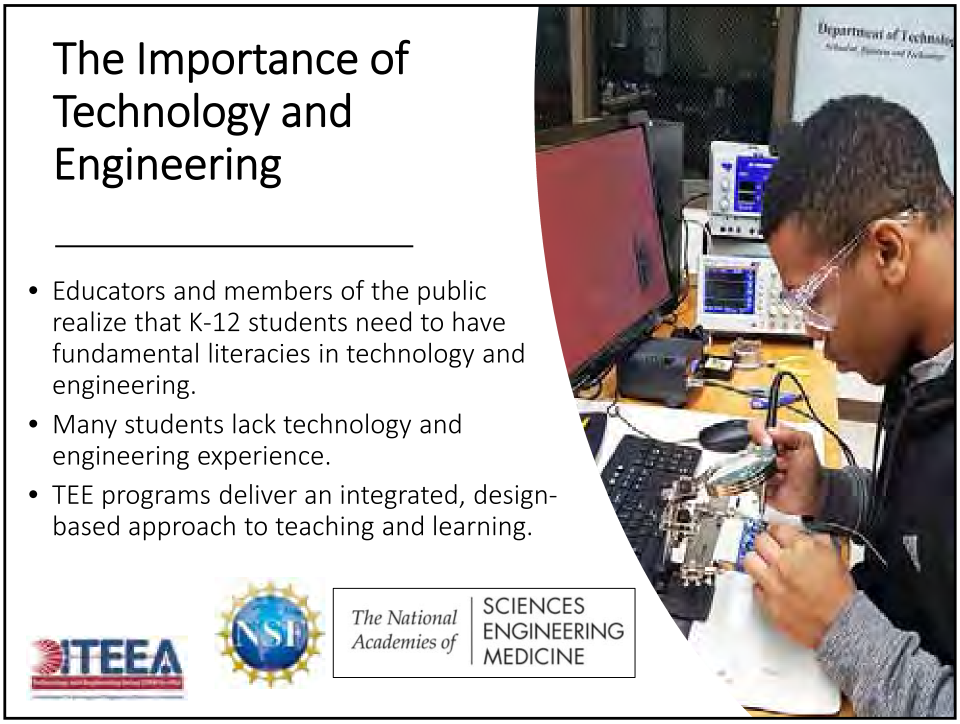
ITEEA's *Standards for Technological Literacy* was published in 2000 and last updated in 2007. In 2016 the executive board of ITEEA's Council on Technology and Engineering Teacher Education set in motion a plan to update STL. A new set of national technology and engineering standards was developed and published in the summer of 2020. This presentation will un-pack STEL so you can use this in your laboratory-classroom and to advocate for TEE and your program.



It is becoming more apparent the differences between individuals and groups in society who understand technology and those who do not. The study of technology and engineering is important for ALL students, whether they are moving into college, a career, or simply to help them understand the complex world they will face every day. Organizations such as the National Science Foundation and the National Academies have shown increasing support for TEE. See the *Power Core Standards Within STEL* document on the ITEEA website for more advocacy information.

The Importance of Technology and Engineering Education

- https://nces.ed.gov/nationsreportcard/tel/

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The National Assessment of Educational Progress Technology and Engineering Literacy Assessment (NEAP TEL) is part of the Nation’s Report Card. NAEP TEL was developed in 2014 and assesses eighth graders nationally for their understanding of technology and engineering. See the NAEP TEL website for the assessment framework, videos, animations, and other resources. A program structured on STEL will prepare students for the NAEP TEL.

Three Dimensions of Technology and Engineering Education

- **Knowing:** taking in information, organizing it, and understanding factual and conceptual relationships
- **Thinking:** making sense of information through questioning, analysis, and decision making.
- **Doing:** using technology and engineering in applied ways such as designing, making/building, producing, and evaluating.

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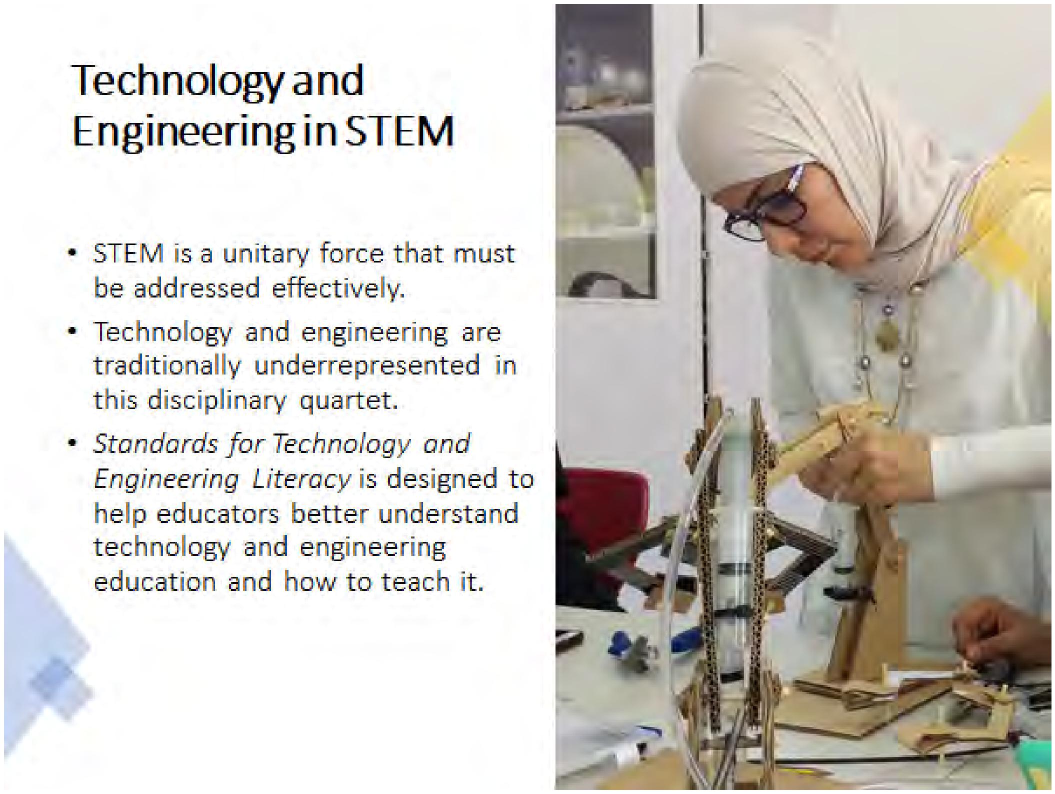
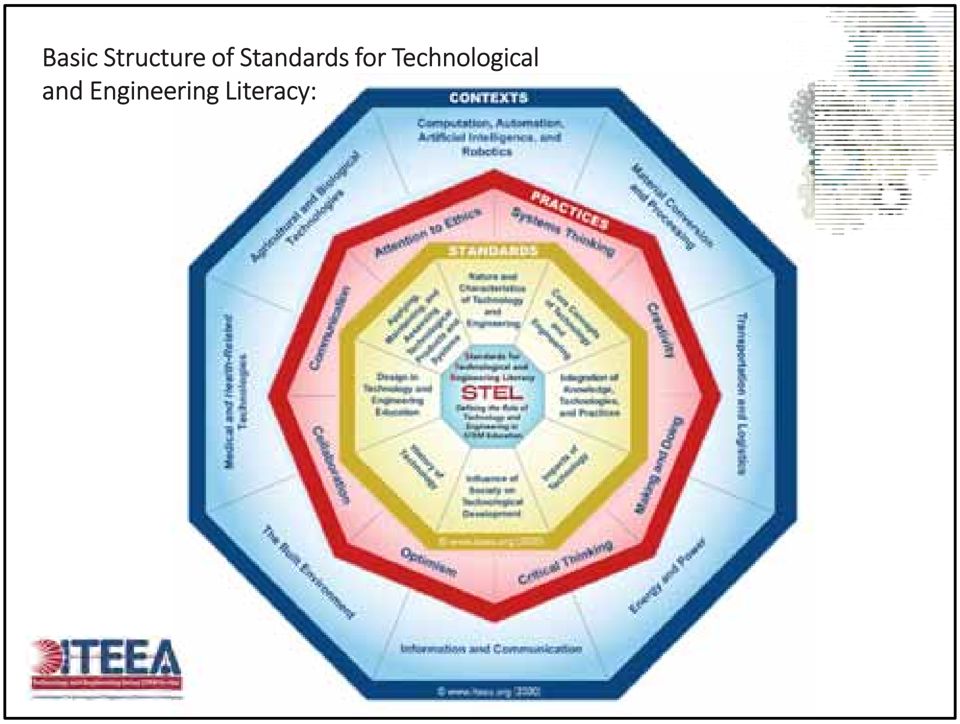
Learning about technology and engineering is not just experimenting with tools and materials to make things or do projects. For over eighty years, the field has been defined by three inter-related dimensions: knowing, thinking, and doing. Truly studying technology and engineering means engaging students in all three dimensions.

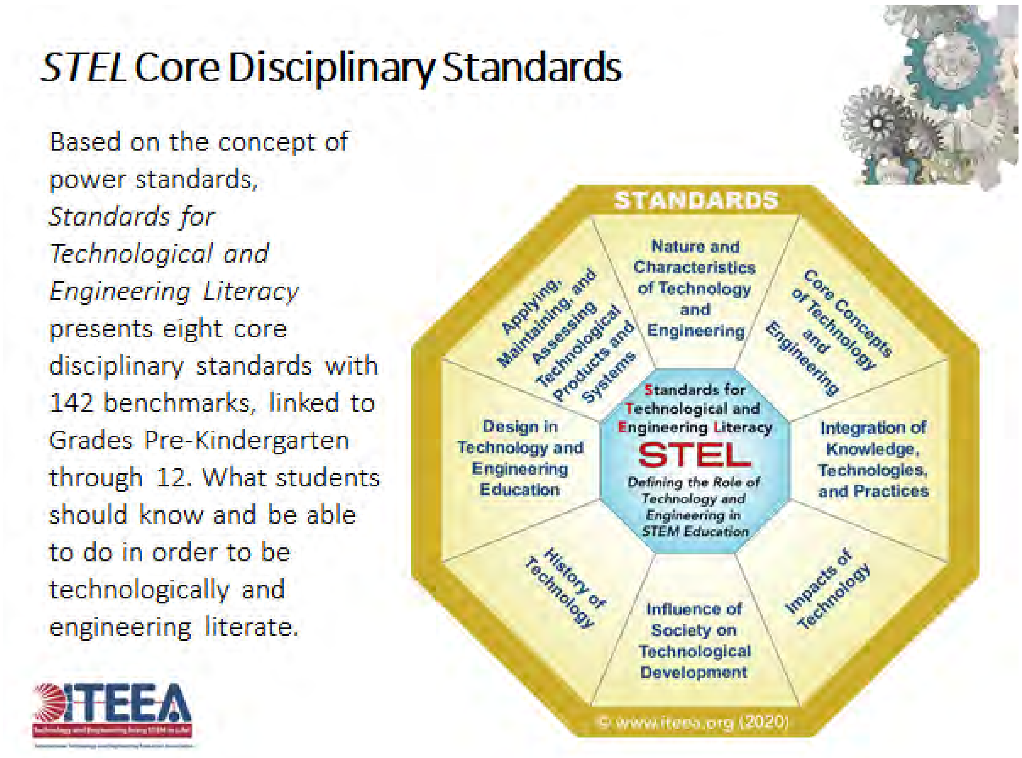


Over the past two decades, educators have come to consensus that the best learning occurs holistically rather than in a content silo. In order to better prepare oneself for college or careers, linking technology and engineering with mathematics, science, and other core disciplines will result in a person who is better able to adapt and adjust to rapid technological changes in their lives.

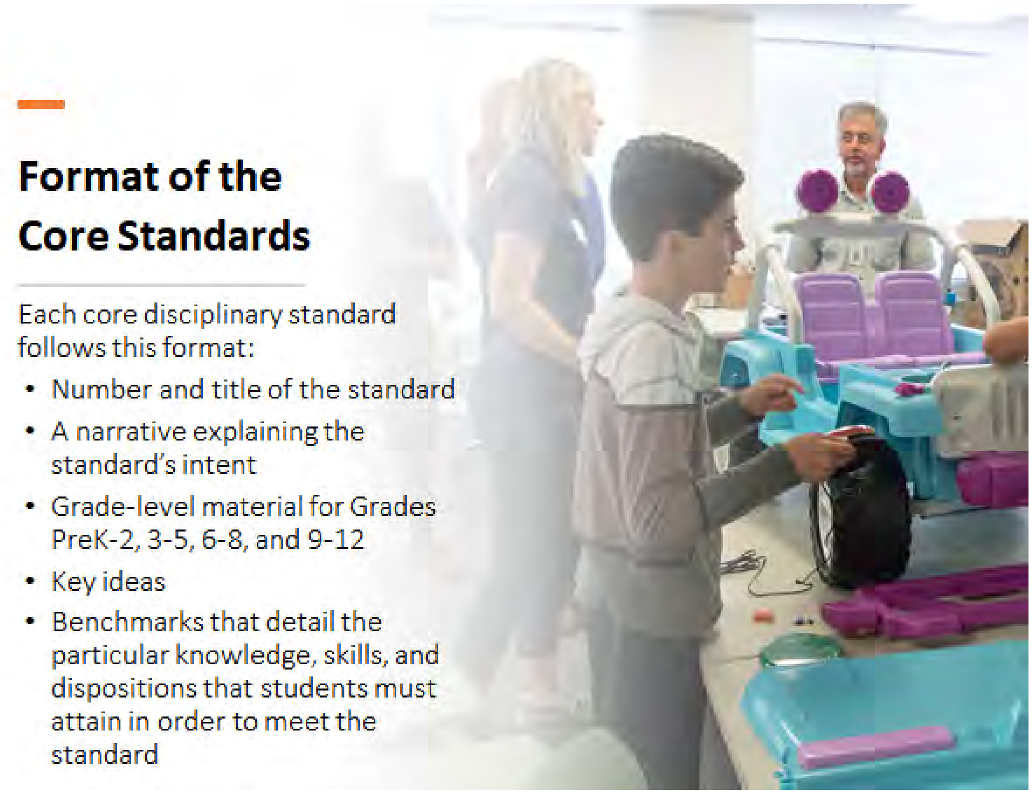
One of the unique aspects about technology and engineering education is the use of technological and engineering design as the primary teaching process. This is very different than college engineering classes that prepare students for a career as an engineer. The teaching of engineering design in PreK-12 education helps all students use an informed design process to solve technological problems.



STEL has three organizers: eight core standards, eight practices, and eight contexts where the standards and practices can be taught. This graphical depiction can be imagined as a set of three octagons that can be rotated to indicate application of the core standards and technology and engineering practices in a variety of contexts. The STEL benchmarks are written with active verbs to target specific developmental levels of the cognitive, affective, and psychomotor learning domains.



The original ITEEA standards from 2007 had 288 benchmarks associated with 20 standards. This wide structure made it more difficult for teachers to know what to teach in their classrooms. Based on research, STEL contains just eight standards and 142 benchmarks that indicate the most fundamental aspects of technological and engineering literacy that a person should know and understand by their graduation from high school.

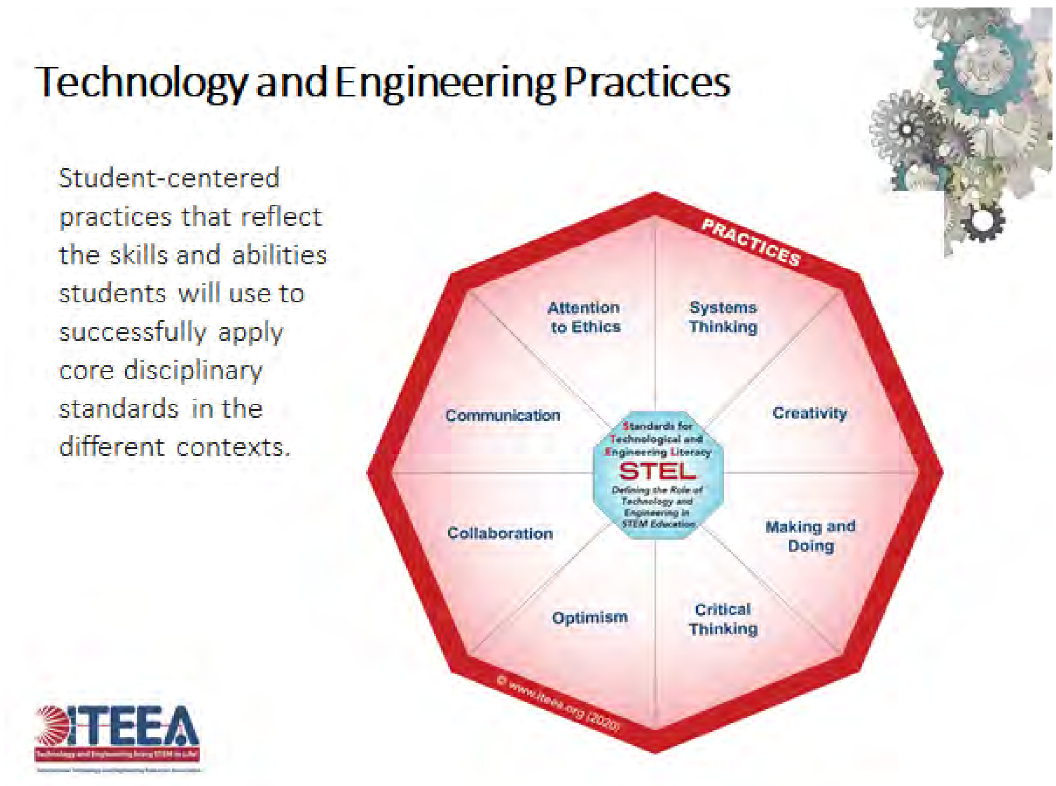


The organization of the STEL standards is easy to follow. Students must study all eight standards to maximize their understanding of technology and engineering. Curriculum developers and teachers should understand the standards and benchmarks for all grade levels and should not assume students have studied technology and engineering in previous grades.

Benchmarks

- Identify the fundamental content elements needed for students to meet each standard.
- Objectives written with active verbs that outline the knowledge, skills, and dispositions that enable students to meet each of the standards at the PreK-2, 3-5, 6-8, and 9-12 grade bands.
- Followed by supporting sentences that provide further detail, clarity, and examples.

The standards and benchmarks have been carefully written to connect the cognitive, affective, and psychomotor domains of learning to the knowing, thinking, and doing dimensions of technology. Each benchmark has examples of use at the different levels from Pre-K to 12th grade.



STEL also includes eight technology and engineering practices that are the personal qualities and attributes all students must develop in order to connect their knowledge and skills learned in the core standards. Based on research and contemporary educational initiatives such as the Engineering Habits of Mind and 21st Century Skills, these practices are written to link technology and engineering standards and contexts. Teachers can help students develop these practices within their lessons, thereby providing students with lifelong personal skills that maximize their technological and engineering literacy.

The study of technology is not linear. Students that study all eight standards and all eight practices will be equipped to understand new and emerging technologies.

Technology and Engineering Contexts

The technology and engineering contexts presented in *STEL* describe the settings where the core disciplinary standards and benchmarks are best taught or applied.

Grades 3-5 Technology and Engineering Context in Computation, Automation, Artificial Intelligence, and Robotics: Third graders can apply STEL-4F: Describe the helpful and harmful effects of technology in a national curriculum on stability and motion that includes programming. These students identify technologies in their world that use automation or artificial intelligence and discuss both positive and negative impacts that could result. To elicit further thinking, students should identify these impacts and suggest potential solutions when designing a system that would utilize automation or artificial intelligence. This example can be linked to TEP-7: Communication.

The eight technology and engineering contexts are the settings where the standards and practices will most likely be taught. These contexts are broader than just traditional course titles. These are the settings we encounter technology and engineering in our lives and in schools they often include student organization activities, regional engineering competitions, personal interests and hobbies, field trips or even specific activities in a mathematics or science classroom. The example given here describes a newer technology and engineering education setting linked to a benchmark from STEL 4 and Practice 7. The inclusion of examples throughout STEL is designed to help teachers and curriculum developers understand how to apply STEL in a very practical way.

Relationships among domains of learning, dimensions of TEE, and student outcomes

Domains of Learning	Technology & Engineering Dimensions	Student Outcomes (as defined by Benchmark verbs)
Cognitive →	Knowing & Thinking →	Knowledge
Psychomotor →	Doing →	Skills
Affective →	Knowing, Thinking, & Doing →	Dispositions

STEL has a sound structure that connects the three domains of learning to the three technology and engineering dimensions and the desired student outcomes (as defined by the benchmark verbs).

Standard Descriptions & Key Ideas

an alphanumeric listing (e.g., STEL-1A, STEL-6B, STEL-7C) and are highlighted in bold type. They are followed by supporting sentences (not in bold) that provide further detail about how the benchmarks can be implemented in order for students to meet the standards.

Standard 1: Nature and Characteristics of Technology and Engineering

The words technology and engineering have many meanings and connotations, some of which were defined and explained in Chapter 1. In order to build a foundation for the study of technology and engineering, students must first gain an understanding of the nature and characteristics of these disciplinary fields. These foundational understandings can then be expanded upon to develop the knowledge, skills, and dispositions that are associated with technological and engineering literacy.

Three key ideas clarify the nature and characteristics of technology and engineering. The benchmarks that follow all link back to these key ideas, with increasing levels of specificity and complexity across the grade bands. The first key idea is that **the study of technology and engineering requires knowledge of the natural world and the human-made world.** Students learn that there are similarities and differences between the natural world and human-made world and that changes in one can have intended and unintended impacts on one or both. A firm understanding of this first key idea will lead to advanced concepts such as designing to imitate nature (biomimicry) and design for sustainability.

A second key idea is that **the study of technology and engineering as a human activity is interdisciplinary.** Many connections have been drawn between science, technology, engineering, and mathematics. However, each discipline brings unique characteristics to STEM education:

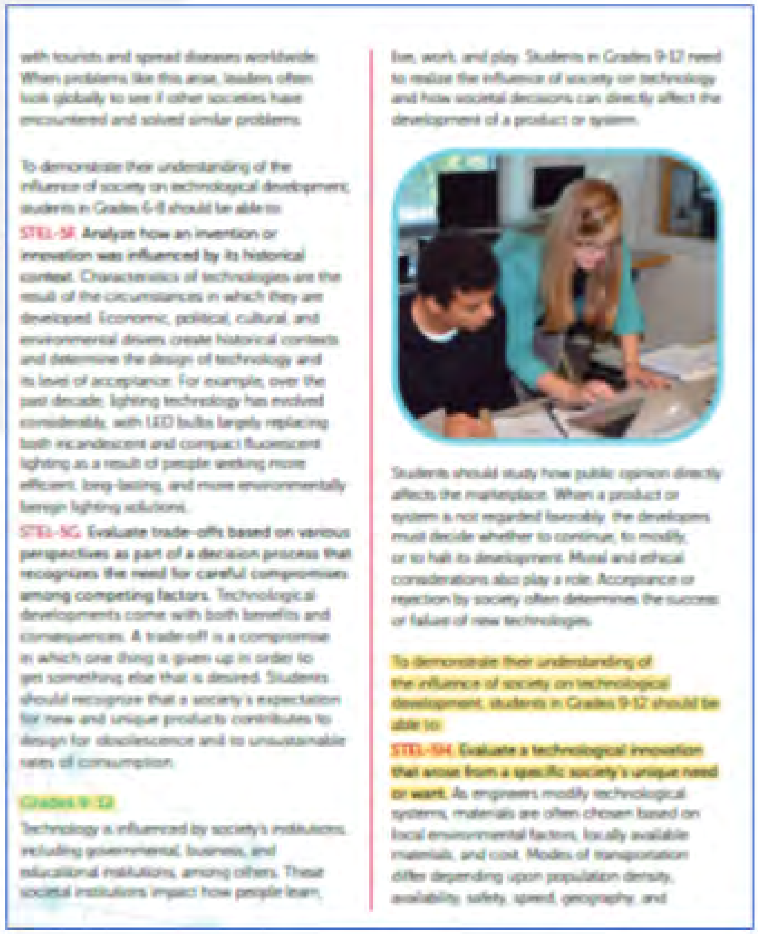
- *Technology* is the modification of the natural environment through human-designed products, systems, and processes, to satisfy needs and wants.
- *Engineering* is the use of scientific principles and mathematical reasoning to optimize technologies in order to meet needs that have been defined by criteria under given constraints.
- *Science* involves investigation and understanding of the natural world.
- *Mathematics* enables communication and critical analysis and is how we make sense of the human and natural world using numbers and computational reasoning.

The study of technology and engineering draws upon knowledge, tools, and processes from across the human experience. This can refer to the processes by which knowledge is obtained and through which technological products and systems are created. It can also be used very broadly in reference to an entire system of products, knowledge, people, organizations, regulations, and social structures (e.g., the technology of the electric grid, or the entirety of the internet).

Although they have some unique characteristics, the design processes used in technology and engineering are similar to the discovery and design processes embedded within other disciplines.

Each standard has a brief narrative and several key ideas to help curriculum developers and teachers with lesson planning. (The third key idea for STEL-1 is that the study of technology and engineering involves the ability to understand, use, assess, and create technological products, systems, and ways of thinking.)

Grade Band Descriptions & Benchmarks



with tourists and spread diseases worldwide. When problems like this arise, leaders often look globally to see if other societies have encountered and solved similar problems.

To demonstrate their understanding of the influence of society on technological development, students in Grades 6-8 should be able to:

STEL-5F. Analyze how an invention or innovation was influenced by its historical context. Characteristics of technologies are the result of the circumstances in which they are developed. Economic, political, cultural, and environmental drivers create historical contexts and determine the design of technology and its level of acceptance. For example, over the past decade, lighting technology has evolved considerably, with LED bulbs largely replacing both incandescent and compact fluorescent lighting as a result of people seeking more efficient, long-lasting, and more environmentally benign lighting solutions.

STEL-5G. Evaluate trade-offs based on various perspectives as part of a decision process that recognizes the need for careful compromises among competing factors. Technological developments come with both benefits and consequences. A trade-off is a compromise in which one thing is given up in order to get something else that is desired. Students should recognize that a society's expectation for new and unique products contributes to design for obsolescence and to unsustainable rates of consumption.

Grades 9-12

Technology is influenced by society's institutions, including governmental, business, and educational institutions, among others. These societal institutions impact how people learn, live, work, and play. Students in Grades 9-12 need to realize the influence of society on technology and how societal decisions can directly affect the development of a product or system.

Students should study how public opinion directly affects the marketplace. When a product or system is not regarded favorably, the developers must decide whether to continue, to modify, or to halt its development. Moral and ethical considerations also play a role. Acceptance or rejection by society often determines the success or failure of new technologies.

To demonstrate their understanding of the influence of society on technological development, students in Grades 9-12 should be able to:

STEL-5H. Evaluate a technological innovation that arose from a specific society's unique need or want. As engineers modify technological systems, materials are often chosen based on local environmental factors, locally available materials, and cost. Modes of transportation differ depending upon population density, availability, safety, speed, geography, and

Each grade band has a description of the appropriate level of knowledge, skills, and dispositions that should be covered. Benchmarks start with action verbs so they can be easily converted to instructional objectives.

Convert Benchmarks to Instructional Objectives

The ABCD method of writing objectives: A is for audience, B is for behavior, C is for conditions, and D is for degree of mastery

STEL	Objective
To demonstrate their understanding of the influence of society on technological development, students in Grades 9-12 should be able to: STEL-5H. Evaluate a technological innovation that arose from a specific society's unique need or want.	Given a country, the student will evaluate a technological innovation that arose from a specific society's unique need or want and has been adopted by most of the people in that country.

The benchmarks have a leading statement that focuses on the student (audience) and an action verb that focuses on the behavior. The condition and degree of mastery is left to the curriculum developer and teacher. Developing curriculum and lesson plans from STEL benchmarks really is that easy.

Review the key terms and ideas in STEL so you can be an ambassador of design-based learning.

STEL Collaborations

1. Help move your school system toward a PreK-12 technology and engineering program for all students.
2. Show your colleagues the logical and authentic connections between and across the individual STEM disciplines.
3. TEE should serve as a bridge to STEM careers.

Be a leader inside and outside your classroom. STEL does bring greater clarity as to what technology and engineering education is and how it fits into the education of all students. We are asking for your help in promoting technology and engineering education, through the adoption of STEL, in your district, the state, and our country.

Accessing *STEL*

STEL is Available in the following formats:

- Downloadable/Viewable PDF (FREE)
- Downloadable/Printable PDF
- EPub Edition
- Print Edition
- Interactive Website (coming soon)

STEL is available in many different formats. In addition, we are working on projects to develop additional resources and curriculum.

Multiple resources are available on the ITEEA STEL website. The *Benchmark Crosswalk* links STEL benchmarks to *Next Generation Science Standards*, *Common Core State Standards mathematics*, and *Common Core State Standards English language arts*. Marketing materials include an FAQ document, videos, presentations, handouts, and other materials. The *Benchmark Verb Matrix* aligns the STEL benchmark verbs to the cognitive, affective, and psychomotor domains. Please check the STEL website frequently for additional resources.

STEL Benchmark Crosswalk to NGSS and CCSS Benchmarks: Valid Matches

5/11/2020

Grade Band	STEL Benchmark	NGSS (2013)	CCSS Math	CCSS ELA
	STEL 1 Nature and Characteristics of Technology and Engineering			
Pre-K-2	**1A.** Compare the natural world and human-made world.	**K-2-ETS1-1** Ask questions based on observations to find more information about the natural and/or designed world(s).	**K.MD.2.** Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference.	ELA-Literacy.SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
Pre-K-2	**1B.** Explain the tools and techniques that people use to help them do things.		**1.MD.4** Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points.	
Pre-K-2	**1C.** Demonstrate that creating can be done by anyone.	**ETS1.A** A situation that people want to change or create can be approached as a problem to be solved through engineering.	**K.G.5** Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.	ELA-Literacy.W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts

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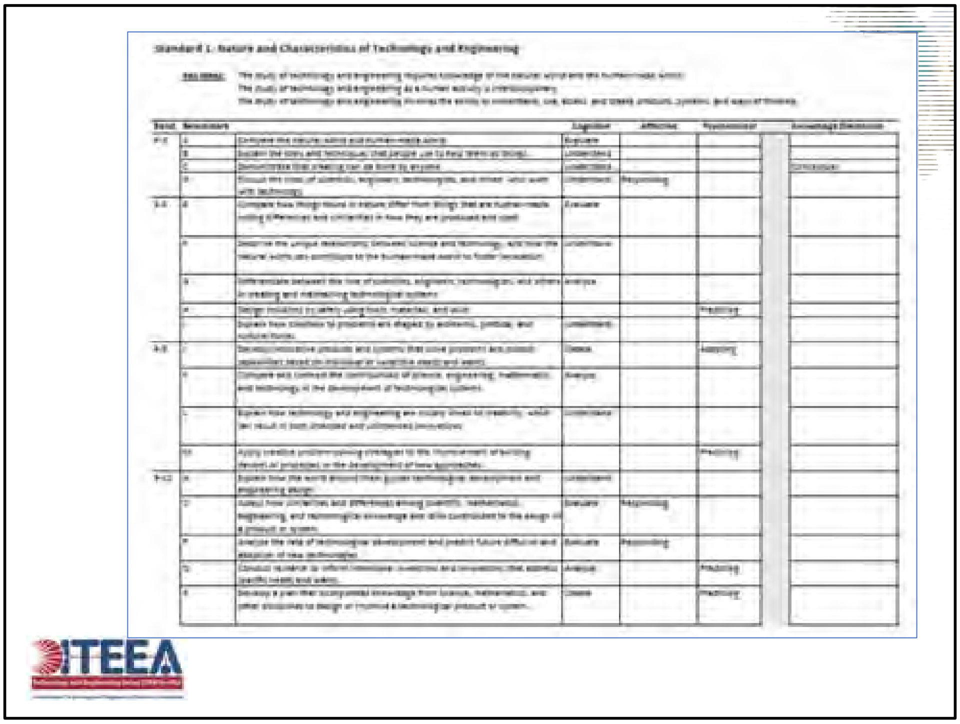

STEL Benchmark Verb Matrix lists the standards, key ideas, benchmarks, and level within the relevant domains of learning as well as the type of knowledge.

ITEEA Is the premiere organization providing information and support for technology and engineering education. STEL is a project of ITEEA that was developed with support from the National Science Foundation and The Technical Foundation of America.