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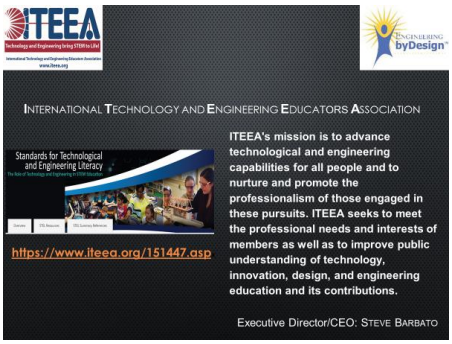
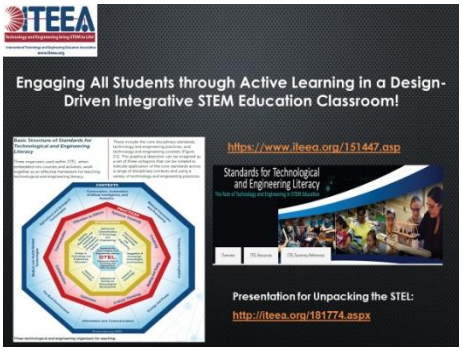
Executive Director/CEO
ITEC 2020 Virtual Conference
(201012-ITEC2020-Unpacking_STEL)

Slides/Narrative [MP4 video available at: https://www.dropbox.com/s/fa07ccie2urzdlh/2020_ITEC_Unpacking_STEL_S_Barbato-Recording.mp4?dl=0]



1 - Thank you for attending this session and thank you to the Illinois Technology and Engineering Education Leadership team for allowing us this virtual opportunity to share exciting news about ITEEA with you. I begin with **ITEEA's mission is to advance technological and engineering capabilities for all people and to nurture and promote the professionalism of those engaged in these pursuits. ITEEA seeks to meet the professional needs and interests of members as well as to improve public understanding of technology, innovation, design, and engineering education and its contributions.**

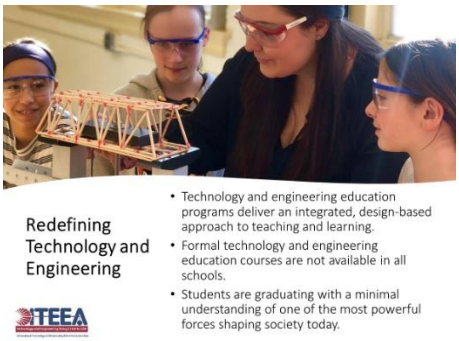


2 - ITEEA strives to provide the necessary supports for educators to engage All Students through Active Learning in a Design-Driven Integrative STEM Education Classroom!

3 - In July, 2020, ITEEA published the new Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education – funded by the National Science Foundation (NSF) and Technical Foundation of America (TFA). . 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. → Next Page →

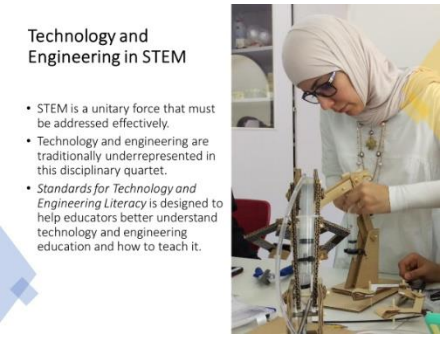
4 - It is becoming more apparent the differences between individuals and groups in society who understand technology and those who do not. The study of technology and engineering is important for ALL students, whether they are moving into college, a career, or simply to help them understand the complex 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

5 = 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.



6 - Technology and engineering education is required for graduation in only a few countries, states, or provinces. Typically, it is an elective program in competition for the same students as art, music, business education, and other career and technical education classes. 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.

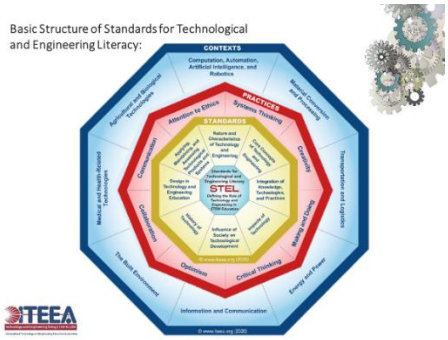
7 - Learning about technology and engineering is not just experimenting with tools and materials to make things or do projects. For over eighty years, the field has been defined by three inter-related dimensions: knowing, thinking, and doing. Truly studying technology and engineering means engaging students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



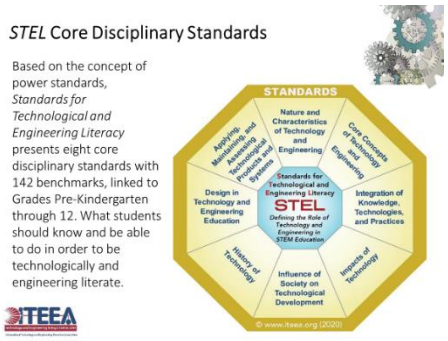
8 - Over the past two decades, educators have come to consensus that the best learning occurs holistically rather than in a content silo. In order to better prepare oneself for college or careers, linking technology and engineering with mathematics, science, and other core disciplines will result in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

9 - 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.

10 - With the varied ways that technology and engineering education is taught across the world, it was apparent that the new standards should focus on the eight critical power standards that all students should know and be able to do. The STEL benchmarks are written with active verbs to target specific developmental levels of the cognitive, affective, and psychomotor learning domains from Pre-Kindergarten through 12th grade.

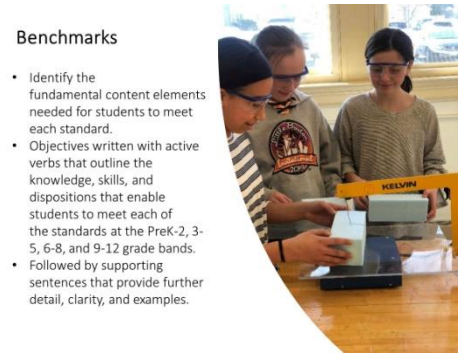


11 - STEL has three organizers: eight core standards, eight practices, and eight contexts where the standards and practices can be taught. This graphical depiction can be imagined as a set of three octagons that can be rotated to indicate application of the core standards and technology and engineering 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.

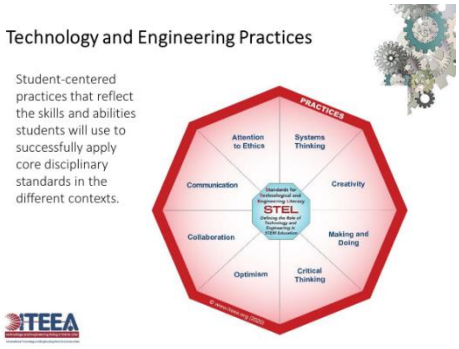


12 - The original ITEEA standards from 2007 had 288 benchmarks associated with 20 standards. This wide structure made it more difficult for teachers to know what to teach in their classrooms. Based on research, STEL contains just eight standards and 142 benchmarks that indicate the most fundamental aspects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

13 - 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.

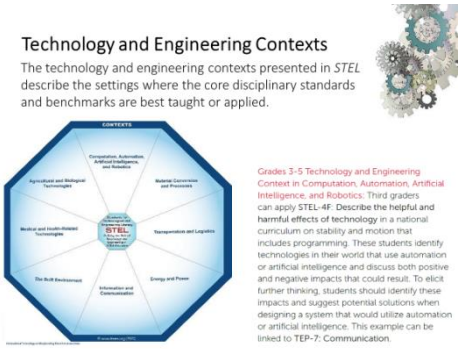


14 - The standards and benchmarks have been carefully written to connect the cognitive, affective, and psychomotor domains of learning to the knowing, thinking, and doing dimensions of technology. Each benchmark has examples of use at the different levels from Pre-K to 12th grade.



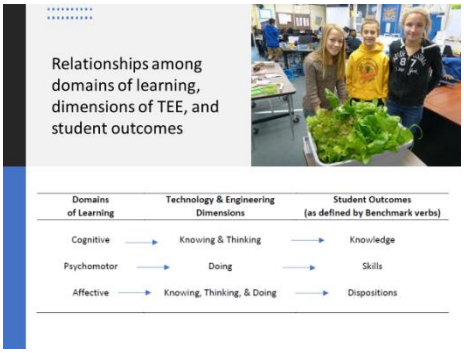
15 - STEL also includes eight technology and engineering practices that are the personal qualities and attributes all students must develop in order to connect their knowledge and skills learned in the core standards. Based on research and contemporary educational initiatives such as the Engineering 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.

16 - 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.



17 - 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 where 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.

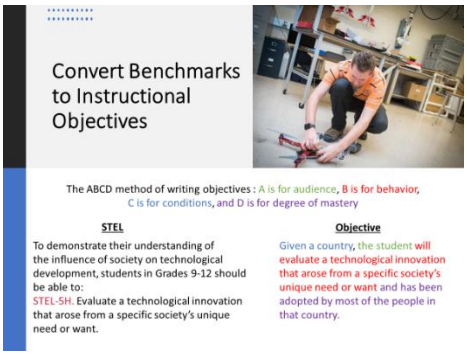


18 - STEL has a sound structure that connects the three domains of learning to the three technology and engineering dimensions and the desired student outcomes (as defined by the benchmark verbs).

19 - 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.)

20 - Each grade band, Prek-2, 3-5, 6-8, and 9-12 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.

21 - When developing a lesson plan, a teacher should look at how a couple of benchmarks can be taught together to address a standard. The benchmarks should be used as the foundational elements for teaching and learning. Each benchmark starts with an action verb that can be easily translated into a measurable assessment strategy.

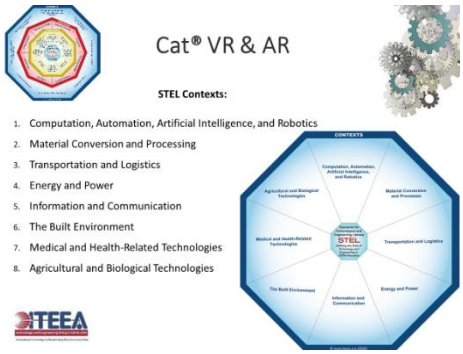


22 - **Converting STEL Benchmarks to Instructional Objectives can be accomplished using the** ABCD method of writing objectives : A is for audience, B is for behavior, C is for conditions, and D is for degree of mastery**.**
The benchmarks have a leading statement that focuses on the student (audience) 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.

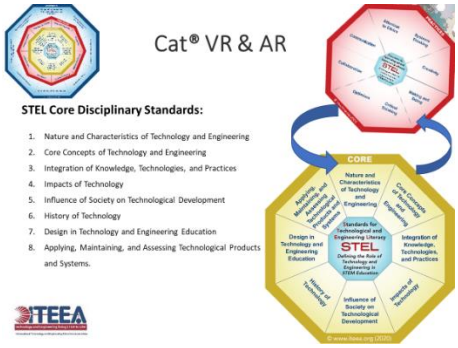
23 - I was informed when being asked to prepare this unpacking STEL presentation that Caterpillar was a keynote session sharing their exploration and use of VR and AR. What does Caterpillar currently do with virtual reality (VR) and augmented reality (AR)? Caterpillar provides training, equipment, and resources that enable a safe and effective learning environment. They provide hands on demos with their VR program that has proven more successful than instruction that takes place in a traditional classroom setting.
CAT incorporates both virtual and augmented reality into trainings. Some examples include safely entering and performing maintenance in a mine, maintenance procedures for service technicians on site, and apps that allow for specific parts of a machines to be analyzed.

In this example video linked to the slide, CAT is using augmented reality to take a better look at 3D models of equipment. Teachers can use augmented reality in the classroom to better engage students and allow them more hands on, visual opportunities and examples. This extremely engaging context matches up well to deliver on several STEL standards with the associated practices.

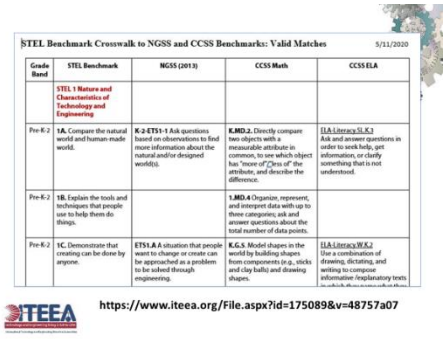
24 - The Caterpillar Foundation and Caterpillar's Innovation & Technology Development share similar goals aligned with ITEEA's mission.
The foundation includes partnerships with schools, innovative ideas and products, concerns for the safety and well-being of trainees and students, and community involvement. They are encouraging the next generation of workers to pursue careers in the areas of Science, Technology, Engineering and Math (STEM.)
STEL provides a USER-Centered Design approach. Examples include the ITEEA REACH Challenge and GoBabyGo project Challenge through the free download in Engineering byDesign. See the links on the slide for accessing these resources.



25 - STEL - Page 105: Technology and Engineering **Context 5** (TEC-5): Information and Communication
- "Information and communication technologies also include the areas of computer-aided design (CAD), video production, podcasting, graphic design, virtual reality, augmented reality, and the internet."
Grades 9-12 Technology and Engineering Context in Information and Communication: STEL-1N: Explain how the world around them guides technological development and engineering design in an information technology unit from a national curriculum during a challenge to unjam urban traffic using spreadsheets and animation software. The context for teaching this lesson could be the impact on society and systems of condensed rush hour windows. The preparation of smart signal systems in many cities has reduced vehicle bottlenecks. This activity links to TEP-1: Systems Thinking.



26 - STEL Page 29 - Standard 2: Core Concepts of Technology and Engineering
A process is a systematic sequence of actions used to produce and output. Beginning students may use trial-and-error or tinkering, but as students advance they need to learn more formal technology and engineering processes. The Informed Design is the process of applying knowledge and creative skills in the development of a product. The processes of making models, as well as modeling in virtual and augmented environments, is used to demonstrate concepts and to try out visions and ideas. Maintenance is the process of working with the parts of a system or the system as a whole to ensure proper functioning and to prevent unnecessary errors. Management, which is the process of planning, organizing, and controlling technology, is used to control resources and to ensure that technological processes operate effectively and efficiently. Assessment of products and systems is the process of asking questions and examining events to uncover deeper patterns or problems. The end goal of assessment is to improve the process or system. Example benchmarks: **Ex: Grades 6-8: STEL-1J.** Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants.

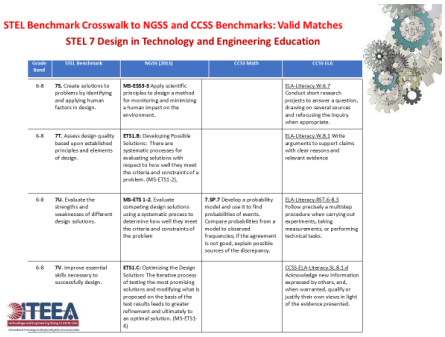


STEL Benchmark Crosswalk to NGSS and CCSS Benchmarks: Valid Matches 5/11/2020

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

https://www.iteea.org/File.aspx?id=175089&v=48757a07

27 - The STEL resources webpage has a link to the STEL Benchmark Crosswalk to the NGSS and CCSS Benchmarks by grade band and benchmark provide an approved list of the Next Generation Science Standards (NGSS), Common Core State Standards for Mathematics and English Language Arts.

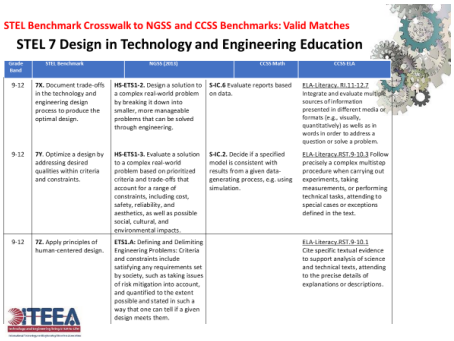


STEL Benchmark Crosswalk to NGSS and CCSS Benchmarks: Valid Matches

STEL 7 Design in Technology and Engineering Education

Grade Band	STEL Benchmark	NGSS (2013)	CCSS Math	CCSS ELA
6-8	**7S.** Create solutions to problems by identifying and applying human factors in design.	**MS-ESS3-3** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		ELA-Literacy.W.6.7 Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.
6-8	**7T.** Assess design quality based upon established principles and elements of design.	**ETS1.B:** Developing Possible Solutions: There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2).		ELA-Literacy.W.8.1 Write arguments to support claims with clear reasons and relevant evidence
6-8	**7U.** Evaluate the strengths and weaknesses of different design solutions.	**MS-ETS 1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem	**7.SP.7** Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.	ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
6-8	**7V.** Improve essential skills necessary to successfully design.	**ETS1.C:** Optimizing the Design Solution: The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)		CCSS.ELA-Literacy.SL.8.1.d Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

28 - This is an excerpt for grade band 6-8 for STEL 7: **Design in Technology and Engineering Education** Benchmark Crosswalk to the NGSS and CCSS Benchmarks provide an approved list of the Next Generation Science Standards (NGSS), Common Core State Standards for Mathematics and English Language Arts. [*Speaker-Share STEL 7 Benchmarks if time allows*] When thinking about how to approach and incorporate new contexts to teach technological and engineering literacy and engage all students, such as VR and AR into your lessons, units and curriculum, this crosswalk provides you with not only the ability to introduce these innovative tools, but also connect them to Bona fide standards in other core disciplines as well!

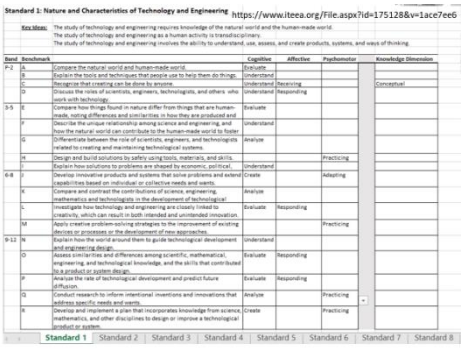


STEL Benchmark Crosswalk to NGSS and CCSS Benchmarks: Valid Matches

STEL 7 Design in Technology and Engineering Education

Grade Band	STEL Benchmark	NGSS (2013)	CCSS Math	CCSS ELA
9-12	**7X.** Document trade-offs in the technology and engineering design process to produce the optimal design.	**HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	**S-IC.6** Evaluate reports based on data.	ELA-Literacy.RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as wells as in words in order to address a question or solve a problem.
9-12	**7Y.** Optimize a design by addressing desired qualities within criteria and constraints.	**HS-ETS1-3.** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	**S-IC.2.** Decide if a specified model is consistent with results from a given data-generating process, e.g. using simulation.	ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
9-12	**7Z.** Apply principles of human-centered design.	**ETS1.A:** Defining and Delimiting Engineering Problems: Criteria and constraints include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and quantified to the extent possible and stated in such a way that one can tell if a given design meets them.		ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

29 - This is an excerpt for grade band 9-12 for STEL 7: **Design in Technology and Engineering Education** Benchmark Crosswalk. The Link to teaching the VR and AR Caterpillar type of educational delivery can be connected to every aspect of the 8 core standards and practices.



Standard 1: Nature and Characteristics of Technology and Engineering https://www.iteea.org/File.aspx?id=175128&v=1ace7ee6

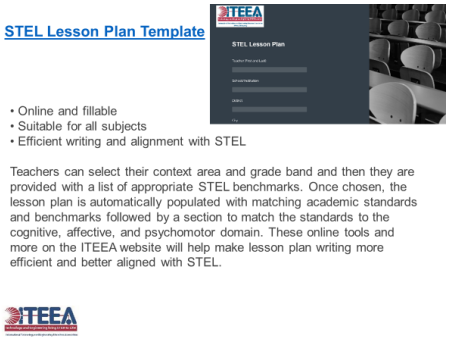
Key Ideas: The study of technology and engineering requires knowledge of the natural world and the human-made world.
The study of technology and engineering as a human activity is transdisciplinary.
The study of technology and engineering involves the ability to understand, use, assess, and create products, systems, and ways of thinking.

Band	Benchmark		Cognitive	Affective	Psychomotor		Knowledge Dimension
P-2	A	Compare the natural world and human-made world.	Evaluate				
	B	Explain the tools and techniques that people use to help them do things.	Understand				
	C	Recognize that creating can be done by anyone.	Understand	Receiving			Conceptual
	D	Discuss the roles of scientists, engineers, technologists, and others who work with technology.	Understand	Responding			
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	Evaluate				
	F	Describe the unique relationship among science and engineering, and how the natural world can contribute to the human-made world to foster	Understand				
	G	Differentiate between the role of scientists, engineers, and technologists related to creating and maintaining technological systems.	Analyze				
	H	Design and build solutions to safety using tools, materials, and skills.			Practicing		
	I	Explain how solutions to problems are shaped by economic, political,	Understand				
6-8	J	Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants.	Create		Adapting		
	K	Compare and contrast the contributions of science, engineering, mathematics and technologists in the development of technological	Analyze				
	L	Investigate how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovation.	Evaluate	Responding			
	M	Apply creative problem-solving strategies to the improvement of existing devices or processes or the development of new approaches.			Practicing		
9-12	N	Explain how the world around them to guide technological development and engineering design.	Understand				
	O	Assess similarities and differences among scientific, mathematical, engineering, and technological knowledge, and the skills that contributed to a product or system design.	Evaluate	Responding			
	P	Analyze the rate of technological development and predict future diffusion.	Evaluate	Responding			
	Q	Conduct research to inform intentional inventions and innovations that address specific needs and wants.	Analyze		Practicing		
	R	Develop and implement a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.	Create		Practicing		

Standard 1 | Standard 2 | Standard 3 | Standard 4 | Standard 5 | Standard 6 | Standard 7 | Standard 8

30 - 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. The key is using this easy to access resource and applying the best action verbs for the teaching and learning experience you are delivering.

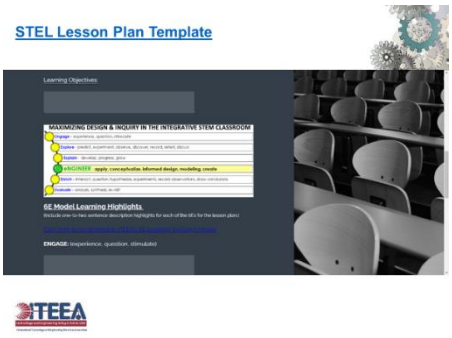
31 - STEL is available in many different formats on the ITEEA.org website. In addition, we are working on projects to develop additional resources and curriculum.



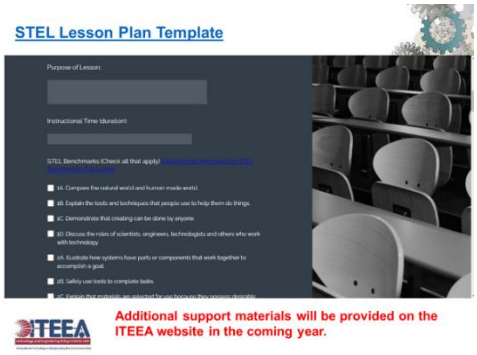
32 - [We are currently working on an interactive APP that will include the STEL Lesson Plan Template]. This will include:

- Online and fillable fields
- Suitable for all subjects to use STEL – Try leading your school PLC-professional learning community on STEM using this tool
- This lesson planning tool will provide an efficient writing and alignment with STEL-

Teachers can select their context area and grade band and then they are provided with a list of appropriate STEL benchmarks.



33 - The 6e lesson format is integrated into the tool that is a value-added component that applies the engineering step to the 5e model.



34 - Additional support materials will be provided on the ITEEA website in the coming year.

35 - 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.

36 - [Review the key terms and ideas in STEL so you can be an ambassador of design-based learning]: It is now time for a call to action! We are at a critically important juncture in our field. It is a must that we all understand and optimize our ability to assure that all students become technologically and engineering literate. We must individually understand and apply technology as a modification of the natural environment through human design products, systems, and processes, to satisfy human wants and needs. Engineering as the use of scientific principles and mathematical reasoning to optimize technologies in order to meet needs that have been defined by current criteria under giving constraints.
And the most important part of connecting technological and engineering literacy as the ability to understand, use, create, and assess the human design environment that is the product of technology and engineering activity.

37 - 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.

38 - Now, the challenge is for educators like yourself to take these and run with them. We encourage you share your STEL connected lessons to the 8 core standards, 8 practices and habits of mind through the wide range of contexts and benchmarks to bring STEM to life for all students! 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.
You are our pathway to assure all children have the opportunity to become technologically and engineering literate. We appreciate your active participation in the Illinois conference and ITEEA! I hope you can join us for our virtual 2021 conference being held March 24-27. See our website for more details. Thank you.