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 The E in STEM: Meaningful Content for Engineering
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Standards Analysis

Which technology education, mathematics, and science standards relate to problem solving or engineering design?

The Next Generation Science Standards, ITEEA Standards for Technological and Engineering Literacy and the New York State Intermediate Science Standards all have significant overlap in the area of engineering design and problem solving.

How are these standards similar to each other?

All three of the identified sets of standards are very similar in the manner in which they regard engineering design problem solving. They share similar language and phrasing when regarding an engineering ideal as a whole. For example, here are three standards of each set which are about evaluating solutions based on constraints:

NYS Intermediate Science Standards	Next Generation Science Standards	ITEEA STEL Standards
<p style="text-align: center;">STANDARD 1 Analysis, Inquiry, and Design: ENGINEERING DESIGN: Key Idea 1: T1.3</p> <p>Consider constraints and generate several ideas for alternative solutions, using group and individual ideation techniques; defer judgment until a number of ideas have been generated; evaluate (critique) ideas; and explain why the chosen solution is optimal.</p>	<p style="text-align: center;">MS-ETS1-2.</p> <p>Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p>	<p style="text-align: center;">Standard 11-K.</p> <p>Test and evaluate the design in relation to preestablished requirements, such as criteria and constraints, and refine as needed.</p>

All three of these standards seek to achieve what is basically the same goal. Many other ideas of common engineering standards are addressed in a similar fashion among these sets of standards including identifying problems, collecting information, and designing and constructing models for solutions.

How are they different from each other?

The most obvious difference between each of the sets of standards is that engineering design problem solving is framed largely for the primary core content of each set of the respective standards. Of the selected standards, the NYS Intermediate Science Standards are the most

different from the others. The NYS Intermediate Science Standards were put into place in 1996 and have the least robust standards as relating to engineering ideals. Unlike the NGSS or STEL Standards, the NYS Intermediate Science Standards do not frame content within the context of the core content to be delivered whatsoever. Engineering design in the Intermediate Science Standards is listed as an expanded process skill, as is interdisciplinary problem solving. Additionally, the yearly state performance test for those standards makes very limited use of either problem solving or engineering design, and offers no blending of those ideas into the core curriculum. These standards are currently being phased out for the NYS P-12 Science Learning Standards which bear a striking resemblance to the NGSS, on which they are based. To contrast, the NGSS makes a more substantive connection between the core content and the engineering design process, presenting avenues for how they may be incorporated into the content itself. Lastly, the STEL Standards have the most extensive definitions regarding engineering standards, and offer approaches for teaching about engineering design. However, the STEL Standards differ from the NYS Intermediate Science Standards or the NGSS in that they are more adaptable across multiple subject areas. Examples of standards which are similar across several popular sets of standards can be found on page 120 of the *ITEEA Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education*, and serve to highlight the adaptability of the STEL standards which are characterized by non-discipline specific vocabulary and are more succinct than the comparable standards from the other sets. Having greater adaptability with concise language makes the STEL standards very useful for unifying across all of the STEM subjects, unlike the other two sets of standards being analyzed which focus primarily on engineering as it relates to the field of science.

What are your thoughts on engineering design problem solving as a “unifying” concept/skill?

Engineering design problem solving serves as an excellent unifying concept/skill. While core content may not transfer very well or at all between different math, science and technology and engineering education standards, problem solving is an essential part of STEM education. The school system in the traditional model creates segmentation between different subjects which causes students to compartmentalize their knowledge specifically for those subjects. Having the ability as a student to apply your knowledge across multiple subjects allows for the generation of more creative and robust ideas, solutions and enhanced perspectives as applied to the student’s coursework. Engineering design problem solving is unique in that as a skill it is easily transferable between STEM courses, helping to strengthen the ties between those respective fields. As the number of STEM positions in the workforce continue to balloon, it is important that greater attention is paid to STEM education at the primary and secondary levels. Almost every professional position within the STEM fields require some degree of engineering design problem solving, and it is therefore imperative that students are best prepared to meet those challenges as they move into the workforce or higher education.