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The “E” in STEM
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Standards Analysis

It is fascinating to observe how the STEM disciplines compliment one another in a coherent and supportive way. While they emphasize different content knowledge, each discipline offers its own perspective and understanding to enrich an integrated STEM project. In a close examination of the math, science, and technology standards, it is evident how they connect to support the engineering and design process.

The study of math emphasizes analytical thinking which helps when defining a problem, identifying strengths, and determining multiple entry points and solutions. The Common Core State Standards for math include not only the many mathematical understandings that students are expected to master, but also emphasize eight mathematical practices that educators should seek to develop in all students. It is through these practices, that we find the strongest alignment to the Engineering Habits of Mind. Math Practice 1 (MP1) encourages students to make sense of problems and persevere in solving them. This kind of thinking is supported in the design process when defining the problem and constraints, as well as staying with the design process even when faced with challenges. MP2 is to reason abstractly and quantitatively, which are essential skills that promote flexible thinking when seeking solutions and evaluating results, as students are asked to decontextualize and contextualize a given situation. MP3 is to construct viable arguments and critique the reasoning of others. This compliments the collaborative nature of the design process, as we are encouraged to clarify our reasoning, listen to other’s perspectives and consider alternate solutions. MP4 refers to modeling with mathematics, where “mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.” (National Governors Association Center for Best Practices, Council of Chief State School Officers) This is a strong connection with the primary purpose of engineering and design which are to solve real problems and make the world a better place.

A major structural component of the Next Generation Science Standards, NGSS, is the emphasis on observing real phenomena in the world around us, making observations and investigating them further. This aligns with the engineering design process since a primary purpose is to resolve real world problems. The NGSS have included a series of engineering practices and standards, where students are expected to engage with major global issues, not only to understand the science behind them, but also to apply strategic thinking to design solutions to our problems. The engineering standards are structured to emphasize defining a problem, through qualitative and quantitative analysis. Then students begin to design possible solutions, while considering the constraints of the problem, and chunking the design into smaller problems that can be solved using engineering methods. The engineering component of the NGSS serves as a call to action, encouraging students to apply their science content knowledge in order to solve real problems, design solutions, and innovate new technologies

As the world grows increasingly more complex, it is important that students understand how technology and engineering has an impact on our lives, society, and environment. The "Standards for Technological and Engineering Literacy provides a vision of what students should know and be able to do in order to be technologically and engineering literate." As such, they are written with the context of engineering in mind, and are a critical component of enhancing student learning of the 21st century competencies. By design the STEL integrates technology and engineering standards while always maintaining a strong connection to the real world.

All three curricular frameworks, CCSS, NGSS and the STEL stress the importance of connecting learning to a real world context. At a closer look, it is evident that problem solving and engineering design are the thread that pulls them together by providing the context of a problem and the call to action for the design. STEM education is so powerful because it connects scientific inquiry, analytical analysis, and engineering design thinking in an integrated, project-based approach with the intention of solving real world problems.

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