

Engineering for All

- Vertical Farming: Fresh Food for Cities
- Water: The World in Crisis

I-STEM Education in Practice

Technology and Engineering Laboratory Context

The Engineering for All middle school course includes two modules: 1) Vertical Farms: Fresh Food for Cities and 2) Water: The World in Crisis. Both modules feature Integrative STEM best practices of design-based learning to develop engineering design and systems analysis skills. Students learn that engineering has great potential to serve the greater social good by solving such critical problems as providing food and water for people around the world. Science and mathematics concepts of turbidity, heavy metal contamination, pollution, crop maintenance, hydroponics, STEM careers related to water, agriculture, and the environment, as well as scale using computer aided design (CAD).



The Grand Design Challenge tasks the students with creating a vertical farm design using a 3D modeling program and to demonstrate an operating hydroponic system. Students use the Informed Design Process to meet the challenge. After students construct their hydroponics system, they must report to the class with data showing successful plant growth.



Mathematics and Science Concepts in a Hands-On, Constructivist Setting

Mathematics and Science concepts used include turbidity, heavy metal contamination, pollution, crop maintenance, hydroponics, STEM careers related to water, agriculture, and the environment, scale using computer aided design (CAD), measurement, and data analysis. Students develop a CAD model that represents their scaled prototype and use it to inform their final design. English-Language Arts skills are incorporated within the format of the STEM notebook to include the writing process. In connecting the content to college- and career-readiness skills, students are tasked with developing a detailed plan for the vertical farm, considering trade-offs. Student teams practice communication and presentation skills by presenting their ideas to their classmates who act in the role of consulting engineers providing critical feedback.

The International Technology and Engineering Educators Association's STEM Center for Teaching and Learning™ has developed Engineering byDesign™, the only standards-based national model for Grades PK-12 delivering technological and engineering literacy through an Integrative STEM Education approach. The Engineering byDesign™ model was built using the following student learning standards and STEM initiatives:

- Next Generation Science Standards (K-12)
- Common Core State Standards (High School / Middle School)
- Standards for Technological Literacy (ITEEA)
- Principles and Standards for School Mathematics (NCTM)
- Project 2061
- Benchmarks for Science Literacy (AAAS)
- National Academy of Engineering's Grand Challenges for Engineer-