



Engaging Youth through Engineering Modules (Curriculum Exchange)

Dr. Susan Atkins Pruet, STEMWorks

Dr. Susan Pruet has been actively involved in STEM education – as a teacher, teacher educator and director of reform initiatives for over 30 years. Since 1998 she has developed and directed two STEM reform initiatives for the Mobile Area Education Foundation (MAEF): the Maysville Mathematics Initiative and, most recently, Engaging Youth through Engineering (EYE), a K-12 workforce development and STEM initiative in Mobile, Alabama. Both initiatives involve valuable partnerships with the Mobile County Public School System, the University of South Alabama, and area business and industry. Change the Equation, a non-partisan, CEO-led commission focused on mobilizing business communities to improve the quality of STEM learning in America, recognized the EYE Modules as one of Change the Equation's STEM Works Programs. Dr. Pruet has served on a number of education boards and committees including vice chair of the Board of Directors of the Alabama Mathematics, Science, Technology, and Engineering Coalition (AMSTEC) and Executive Board member of the American Society of Engineering Educators (ASEE) K-12 Division. Dr. Pruet received her undergraduate degree in mathematics from Birmingham-Southern College, her master's degree in secondary education from the University of Alabama in Birmingham, and her doctorate from Auburn University in mathematics education. Currently Dr. Pruet is an independent consultant as President, STEMWorks, LLC, and Founding Director, Engaging Youth through Engineering.

Ms. Melissa Divonne Dean, Mobile Area Education Foundation

Melissa Dean is a respected leader in STEM education based on engineering content in the Mobile, Alabama community. For the past few years she has served there as Assistant Director of the Engaging Youth through Engineering Program at the Mobile Area Education Foundation. In that capacity, she has coordinated the development of a series of STEM modules for middle school grades that truly integrate science, technology, engineering and mathematics learning in the classroom. She is an experienced science educator having lead for years the development of informal curriculum and programs for the Science Centers in Alabama and Louisiana. She is highly experienced in curriculum development, writing, training and implementation. She has lead teacher development programs, as well as conducted pilot engineering design lessons in the classrooms. She works closely with STEM teachers in the 60,000 students Mobile County Public School System and has the reputation as a teacher leader and change agent. Her work with K-12 students, teachers and education administrators is gaining attention and respect nationally. Melissa Dean received her bachelors of science from Louisiana State University in Shreveport and is currently working toward her graduate degree in Instructional Design and Development at the University of South Alabama in Mobile.



**Engaging Youth through Engineering (EYE) Modules:
Integrating and Bringing Relevance to Core Middle Grades Mathematics
and Science Content (Curriculum Exchange)**



Grades 6 – 8

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Background

Engaging Youth through Engineering (EYE) is a partnership-driven K-12 economic development initiative underway in Mobile, Alabama that is spearheaded by a local non-profit education entity in collaboration with a large urban school system, higher education and area business and industry. Its purpose is to produce high school graduates eager and able to meet the growing demand for tech-savvy workers who are also innovative problem solvers. EYE uses engineering design challenges to bring practical relevance and rigor to K-12 math and science curriculum. At the middle grades level, local and National Science Foundation funding are enabling EYE to develop a set of integrated STEM instructional units, the EYE Modules, to inspire and motivate all middle grades students, especially those typically underrepresented in STEM, to take the high school courses needed in preparation for 21st century workforce needs. Each EYE Module is designed such that students use engineering practices and apply required mathematics and science content to develop solutions to relevant problems facing humans today, fostering the development of engineering “habits of mind.”

The set of eight EYE Modules are comprehensive and extensive instructional guides for middle grades teachers to implement collaboratively in mathematics and science classes. The Modules address standards-based STEM content and practices that fill gaps between state-mandated and tested content and what business and industry say they need, including innovative problem solving, communication and teamwork skills. Module specific professional development and implementation materials kits accompany each Module. The Modules are not a complete engineering, technology or STEM curriculum; rather they supplement and support the existing mathematics and science curriculum. They are a set instructional guides that use design challenges and the

engineering design process to engage middle grades students in pursuing STEM careers and academics. The set of eight Modules with their grade level “Launcher” lessons involve about 50 hours of STEM exposure for each student during the three middle grades years (6th, 7th, 8th). Each *EYE* Module requires from 6 to 10 lessons implemented in a combination of math and science classes. While the Modules are designed to be used as a set, they may be implemented as independent units as well.

GRADE	DESIGN MODULE	ENGINEERING FIELD	SCIENCE CONTENT	MATH CONTENT
6	Harnessing the Wind	Mechanical Engineering	Energy Transformation	Making predictions from graphs
6	Don't Go With the Flow	Environmental Engineering	Watersheds	Unit Rate, Centers of Data
7	EYE on Mars	Biological Engineering	Characteristics of Living Things	Analyzing multiple data sets
7	To Puppies & Beyond	Genetic Engineering	Mendelian Genetics	Compound Probability
7	Catch Me if You Can	Biomedical Engineering	Circulatory System	Proportionality, Unit Rate
8	Let's Get Moving	Mechanical Engineering	Newton's Laws	Slope as Rate of Change
8	Matter of Importance	Materials Engineering	Conservation of Matter, Balancing equations	Apply volume of geometric solids
8	Electromagnetic Motor *Under development	Electrical Engineering	Potential/Kinetic Energy	Functions

Documented Results

A longitudinal comparison study of the impact of the EYE Modules on students was begun in 2011 following the cohort of 6th grade students as they experience the finalized set of 8 Modules. This study will be completed in 2014. Other studies involving cohorts of students who experienced early drafts of the Modules in 6th – 8th grades are producing encouraging indications of their impact on students, teachers, and the district. Results show the draft Modules positively impacting students' interest in STEM careers and STEM capacity. This data also indicate EYE students know more about engineering, are more interested in work resembling that found in STEM careers, are more receptive to science labs and other hands on activities, and are more likely to have had a teacher or counselor talk about STEM fields than those in a matched comparison school. Standardized test data are showing a positive impact on Module-specific science and mathematics content and that EYE may also be having an even greater impact on groups underrepresented in STEM, such as African-American students.



Qualitative data from multiple sources indicate a new and beneficial collaboration between the mathematics and science teachers following multiple years of using the Modules. In addition, teachers report they now see strengths in many of their students that previously had gone unrecognized, specifically students receiving special education services. Often the special education students become the team leaders, gaining newfound respect from their classmates.

One compelling summative finding has already emerged from the study: the Modules have served as a catalyst for a large urban school system (60,000 students, 17 middle schools, over 70% poverty) to initiate STEM reform. According to the superintendent, as a direct result of the EYE Modules the school system has developed and implemented revised mathematics and science standards that incorporate engineering. And, to ensure sustainability of these reform efforts, the school system has established a new district level position, STEM Resource Teacher, and hired one of the teachers involved in the EYE Module development and field tests.

Potential Applications

Besides using the EYE Modules to bring integrated STEM to core middle grades mathematics and science classes, other applications of the Modules are emerging. One involves using the EYE Modules as part of a STEM professional development offering for districts in the Boston region that are interested in integrated STEM at the middle grades. Districts send grade level pairs of middle grades teachers to learn about integrated STEM through study and implementation of the EYE Modules. Graduate level course credit is provided for participants who complete the week-long summer workshop, implement the Modules, and complete follow-up activities, including gathering implementation data.

Another interesting application of the Modules is their use in building leadership capacity for STEM sustainability at multiple levels - including business/industry leaders; school district administrators; instructional specialists, informal and formal educators of teachers; and classroom teachers. The Modules serve as a concrete example of how engineering can be used to integrate STEM content and minimize STEM silos at the middle grades level, enabling these potential STEM leaders to better advocate for and support STEM education for all students.