University of Michigan
Provost's Teaching Innovation Prize

2012 WINNER

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Experiencing "True Engineering" Earlier: Learning Concepts by Teaching to High School Students

Innovation Description

Inviting Ypsilanti 10th graders to serve as an audience for "science fair-style" presentations by undergraduate engineering teams is a multi-faceted innovation. Beyond motivating individual undergraduates to learn concepts more thoroughly as they figure out how to teach them, the format supports STEM retention in several ways.

First, putting the onus on undergraduates to creatively link real-world applications to chemical engineering principles increases interest and excitement. This matters because STEM attrition increases when students feel bored or don't see the relevance of abstract theory. Second, encouraging collaboration and teamwork over individual competition improves the climate of the learning environment, particularly for women and members of historically underrepresented groups. Third, when undergraduates design high quality, inexpensive demonstrations that can be used by high school teachers, science learning is improved and students are better prepared for college. Finally, getting kids excited about what chemical engineers are able to achieve, from manufacturing candy to purifying water, helps attract diverse students to the STEM pipeline.

A total of 145 undergraduates (29 teams) and thirty 10th graders participated in the inaugural project. Other professors have easily included the project format in their own courses, and it has the potential to be incorporated into senior-level product and project design courses.

Student Comments

"The ChE 342 project was one of my first experiences of true engineering. Unlike the prior courses that explained the theory, this project brought science to application."

Rather than performing easy science experiments, "we were to demonstrate a complex and intriguing physical phenomenon, explain it with math and engineering principles, and connect it to the real world."

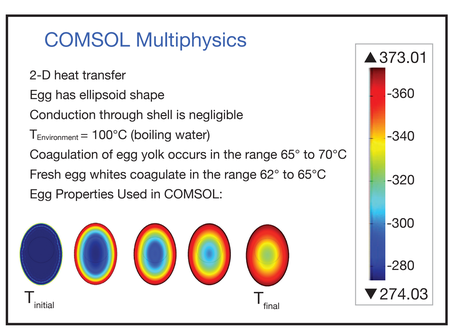
"The design of the demonstration required critical thinking about how any number of complex topics could be condensed down to a simple, quick, inexpensive, and safe demonstration that would both captivate and educate a high school audience."

"Being able to explain a concept to somebody else, especially somebody who has minimal background knowledge of the topic, is the ultimate test of one's understanding of that concept."

"We demonstrated that Styrofoam served as a better insulator than aluminum against a cryogenic solution….The high school students were in awe at this basic scientific principle at work....I hope we piqued their interest in pursuing advanced studies in STEM fields."

Examples of Teaching Innovation

This team went beyond designing a heat transfer experiment by building a website to encourage replication of the demonstration in the K-12 classroom.



COMSOL Multiphysics (engineering simulation software) was used to model heat transfer through an egg.

photo by Christine Moellering

High school participants surveyed in 2008 "learned something new" from 83% of the demos, and 74% of the demos "made them highly interested in engineering."

Follow the QR code for more information on the ChE 342 - Group 23 experiment.