Development of a Semester Long High School Introduction to Engineering Design Course for a Prototypical Classroom (Curriculum Exchange)

Dr. Jacob L. Segil, University of Colorado at Boulder

Jacob L. Segil is an Instructor for General Engineering Plus and Mechanical Engineering degree programs at the University of Colorado Boulder. Jacob has a B.S. in Mechanical Engineering with a minor in Bioengineering from the University of Illinois at Urbana-Champaign, a M.S. in Mechanical Engineering with a Bioengineering focus from the University of Colorado Boulder, and a Ph.D. in Mechanical Engineering from the University of Colorado Boulder. Jacob researches brain-machine interfaces, neural prosthetic devices, and engineering education.

Mr. Brian Huang, Sparkfun Electronics

Brian Huang is an Education Engineer for SparkFun Electronics, a cutting edge open-source hardware and electronics education company. Brian started his career in engineering with wireless transport technologies for ADC Telecommunications in Minneapolis, MN. While working at ADC, Brian volunteered at the Science Museum of Minnesota and quickly discovered a passion for teaching and working with students - especially in an environment that fostered and supported the "wow" factor associated with inquiry and discovery. In 2007, Brian left the world of engineering to pursue a career in education. For the past 5 years, Brian has taught various levels of high school physics, mathematics, applied technology, and robotics.

Brian joined Sparkfun Electronics to help integrate "tinkering," electronics, and computational thinking into the classroom. One of his goals is to help teachers to de-mystify how household consumer electronics work. With a few simple tools, classrooms can excite and encourage students to explore the possibilities of microcontrollers, electronics, and physical computing.

Brian Huang has a Bachelor’s of Science in Electrical Engineering from the University of Illinois, Urbana-Champaign and a Masters in Education from the University of Colorado, Boulder.

Dr. Lindsay Diamond, SparkFun Electronics

Lindsay Diamond is the Director of Education at SparkFun Electronics, a cutting-edge open source hardware company with a keen interest in STEM education. Lindsay received her Bachelor of Arts in Kinesiology and Applied Physiology from University of Colorado, Boulder and Doctorate in Biomedical Sciences from University of Florida College of Medicine.
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Target Grade Level: 9-12th grade

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Curriculum Link:
https://canvas.instructure.com/courses/876545

Curriculum Summary:
The SparkFun Introduction 2 Design (SI2D) High School course provides an introduction to engineering through a series of team-based design projects using products from SparkFun Electronics in a typical high school classroom. This curriculum was based on a First Year Projects Course taught at the [University] and is now being studied during a semester-long pilot at [High School] as described by [another ASEE 2015 K-12 paper submission]. Students learn key engineering skills in various disciplines including electrical, mechanical, and software design. Also, students practice written and oral communication, teamwork, and management of long-term team-based projects. The 18-week course integrates low-cost, open-source products in order to transform a prototypical classroom into a modern engineering design facility.

The curriculum consists of three main elements: lectures, workshops, and design projects. The lectures introduce important engineering design concepts like the design loop as well as technical content on various engineering disciplines. Workshops are interspersed throughout the course to provide practice in technical skills required for the successful completion of the design projects. Workshop topics include circuit design, soldering, computer aided design, Arduino coding, and others. The lectures and workshops use low-cost open-source products to integrate hands-on learning in any classroom.

In this course, students engage in two major design projects to provide application and context to the lectures, workshops, and lessons. The first project is a short-term (two week) introductory design project. It is a fast-paced design project that is meant to force teams into making rapid design iterations and apply basic skills in design. The scope of the project is smaller than the final design project and therefore the time and materials are more constrained. The final design project is a long-term (twelve week) expansive design project that requires teams to develop custom electrical, mechanical, and software prototypes that integrate the SparkFun products used throughout the course with parts and materials readily available at the average hardware store.

The project includes many milestones to ensure progress by the team and builds upon the SparkFun Simon Tilts device in order to create a unique design. The SI2D High School course converts a classroom with only power outlets and community computers into an advanced design facility.