Rethinking Electronics Industry
Workforce Development

Case Studies on High School and Middle School Students with Semiconductor Design and Advanced Electronics Prototyping

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Growing electronics workforce needs

Gap
Build a diverse pipeline of engineers and computer scientists, which require years of STEM education:

- Congress should invest in evidence-based CTE programs in middle and high schools to ensure that students are prepared to be successful in a variety of fields, including in advanced STEM fields. Funds should increase access to computer science and create high quality career pathway programs in middle and high schools, prioritizing models that allow students to earn college credit or result in a credential, and that connect underrepresented students to STEM and in-demand sectors, including programs that leverage partnerships between schools, community colleges and employers.

Doing Things Differently – Key Questions

• How do we **inspire** more people to enter the STEM workforce?
• Is it **possible** for high school/middle school students to learn advanced electronics & semiconductor design?
• How much can be **accomplished** by students during an eight-week pilot?
• What **mentorship** level of effort is needed to achieve student success?
• What opportunities exist to **lower the barriers** of entry for new electronics industry workforce?
A Practical Approach – Jumping Right In

• 8-week Semiconductor Design pilot with high School student interns
  • Mix of student applicants, selected candidates with interest & self-directed learning
  • Analog & digital flows of constraint problem – transistors & ring oscillators
  • Skywater Open PDK and OpenFlow EDA design tool suite

• 40-hour Advanced Electronics Prototyping class with high School & middle school students
  • Class materials adapted from professional level cross-disciplinary training course
  • Electronics prototype development process
  • Didactic & practical sessions
  • Student chosen real-world problem and solution
Semiconductor Design Pilot Process

1. Learn foundational knowledge on semiconductor manufacturing and design.
2. Custom transistor design and seven-stage ring oscillator using analog design flow.
3. Custom ring oscillators and layout using digital design flow.
4. Full integration of a 115-stage ring oscillator using the complete EDA tool suite.
Flow and getting design on the chip

19 Ring Oscillator

115 Ring Oscillator
Prototype Development Process

- Concept
  - What do you want this widget to do?

- Requirements
  - What are the functional details?

- Architecture
  - Diagram on connected functions

- Design Review
  - Compatibilities
  - Circuits & DFM

- Specification of Components
  - Bill of Materials

- CAD Schematic / Netlist / Layout

- Manufacturing

- Assembly

- Test

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10th Grade: 4 Channel DC Motor Controller
10th Grade: Smart Watch
7th Grade: Lightsaber Soundboard
Student Perspectives

• School STEM experiences need to inspire technical innovation
• School STEM experiences need focused depth & breadth
• Student ideas on how industry and schools can partner better:
  • High school career fairs
  • Regular engagement with industry members
  • Conduct industry specific STEM camps or industry-led short courses
Rethinking Electronics Workforce Development

• Integrated approach to electronics workforce education
  • Streamline foundational knowledge acquisition
  • Apply to real-world problems (experiential learning)
• Inspire curiosity, self-directed learning, and purpose
• Meet students where they are
• Longer-term mentoring relationships

A “shift left” perspective towards high school and middle school workforce development can significantly contribute to building a more robust talent pipeline
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Relative Percent of Education Levels of Largest Detailed STEM Occupations in Semiconductor and Other Electronic Component Manufacturing (NAICS 3344)

Source: 2015 and 2016 American Community Survey Public Use Microdata, U.S. Department of Commerce

Back to bASICs Course

New for 2023

Back to bASICs

Source: https://beaverworks.ll.mit.edu/CMS/bw/BWSI_Course_bASICs

Beaver Works Summer Institute will offer a brand new course on open source semiconductor design and fabrication this summer. This course will give students a fundamental and working knowledge of the building blocks of today's electronic world—knowledge that will benefit the student no matter what they decide to pursue academically. Students will receive hands-on experience on how to design and arrange semiconductors on a nanometer scale to perform a specific function. Students will start with a blank canvas (silicon substrate) and learn how to take a specification through the entire design process—including foundry manufacturability. Once complete, the student's design will be sent to a foundry for fabrication. Six months later we'll host a class reunion and the students will be provided a dev kit with their custom design permanently etched in silicon—a milestone to be treasured for a lifetime.