Collaboration Can Improve Engineering Education

Chris Deckard
Physicist / Mathematician

SPAWAR Systems Center Pacific
National Defense Education Program
“The scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength”

2005 National Academy of Science

“So I want to persuade you to spend time in the classroom, talking – and showing – young people what it is that your work can mean, and what it means to you … Think about new and creative ways to engage young people in science and engineering, like science festivals, robotics competitions, and fairs that encourage young people to create, build, and invent – to be makers of things.”

4/27/09 President Barack Obama to the National Academies
National Defense Education Program

**VISION**
A diverse, world-class STEM talent pool with the creativity and agility to meet national defense needs

**MISSION**
Inspire, develop and attract the STEM talent essential to deliver innovative solutions for the Nation’s current and future challenges

**GOALS**

**INSPIRE**
A Nation of students, parents, teachers, and the public inspired to engage in STEM discovery and innovation.

**DEVELOP**
A future world-class STEM workforce talent pool.

**ATTRACT**
A dynamic and innovative work environment in DoD that attracts and retains world-class STEM talent.

**DELIVER**
A coordinated, collaborative, and cohesive set of DoD STEM programs that inspire, develop, attract, and retain world-class STEM talent.

**OBJECTIVES**

- Increase the awareness and importance of STEM and foster discovery and innovation.
- Provide opportunities and resources for learning and personal growth that stress academics, knowledge, skills, abilities, and attributes required for STEM discovery and innovation.
- Strengthen, expand, and enable communities of stakeholders to provide a continuum of formal and informal STEM programs and opportunities.

- Identify current and future STEM workforce needs.
- Increase the diversity of participants in STEM programs.
- Build a portfolio of DoD STEM programs to cultivate the desired competencies of the talent pool.
- Increase the number of military personnel with STEM competencies that transition into the defense workforce.

- Identify programs and best practices that attract and retain world-class STEM talent.
- Ensure a DoD work environment that attracts and retains world-class STEM talent.
- Strengthen and promote the awareness of STEM-relevant opportunities within DoD.

- Develop a systematic approach to identify STEM education and outreach programs across the DoD components and agencies.
- Provide and maintain a publicly accessible inventory of DoD STEM programs.
- Implement a STEM inventory communications strategy.
A DoD-wide program that addresses DoD’s challenge to educate, train, recruit, and retain scientists and engineers in Science, Technology, Engineering, and Mathematics (STEM) critical skill shortfall disciplines for National Security and Defense needs.

**Pre-College K-12 Program**
- Provides STEM professional development
- Partners Defense S&E’s with school teachers
- Stimulates student interest in STEM careers with LabTV videos at NDEP website ({www.ndep.us})

**SMART Education (Undergrad/Grad)**
- Provides scholarships and fellowships in Defense STEM critical skill shortfall disciplines
- Requires clearable US citizens and 1:1 employment pay-back obligation
- Connects students to DoD laboratories and provides mentoring by DoD scientists and engineers (S&E’s)

**NSSEFF = National Security Science and Engineering Faculty Fellowships**

**SMART = Science, Mathematics And Research for Transformation**

**NS S&E FF (Faculty Research)**
- Engages distinguished, clearable research university faculty to pursue long-term, critical DoD research
Naval STEM Overview

Best Practices • Naval Relevance • Diversity • Metrics • Program Bridging

Engage • Educate • Inspire • Employ

STEM2Stern
Opening Minds • Capturing the Future

Collaborate
Vision

To foster a culture that celebrates education – particularly in the sciences, technology, engineering and mathematics through empowering STEM professionals to bring an added “richness” to their communities.
Important Questions

• What do you want to be when you grow up?

• Are you planning on attending college?

• What major or career path do you want?
Chris Deckard’s Answers at age 12

• What do you want to be when you grow up?
  Do I have to grow up?
• Are you planning on attending college?
  Yes
• What major or career path do you want?
  NOT A CLUE!!!!!
How Chris Deckard Got Here
Mirror Exploration

• Explore Mirrors

• What do you notice about mirrors?
• What are some properties you discovered?
Mirrors and Light

• Use flashlights with mirrors

• What happens to the light when it is directed at the mirror?

• Does it matter how you angle the flashlight on the mirror?
Mirrors and Light

• Place the comb between the flashlight and the mirror. Repeat your explorations.

• What happens to the light when the comb is added?

• Are the properties you discovered similar?
Science Research

- 405 nm – InGaN blue-violet laser, in Blu-Ray and HD drives
- 473 nm – Bright blues laser pointers, still very expensive
- 532 nm – AlGaAs Bright green laser pointers,
- 635 nm – AlGaInP better red laser pointers, same power subjectively 5 times as bright as 670 nm one
- 785 nm – GaAlAs CD drives
- 650 nm – AlGaInP DVD drives, laser pointers
- 670 nm – AlGaInP cheap red laser pointers
- 1064 nm – AlGaAs Fiber optic communication
- 1310 nm – fiber-optic communication
- 1480 nm – pump for optical amplifiers
- 1550 nm – fiber-optic communication
Folding a laser beam

Use the mirrors, protractor and string to set up a path for a laser beam to travel and hit a target.

When ready, ask for laser to test.

Three tries and best score on the target board recorded
Laser Technologies

Research
Military
Medical
Common
• Music from MP3 player converted to light and is transmitted through the Light Emitting Diode.

• The smaller box has a photoresistor (receives the light) and converts it back to audio signal and can be heard through the earbuds.
Communication with Light

- Investigate separation distances between the two boxes and still hear the music
- Does the angle the light is pointed at the receiver matter?

- Try using the laser pointer instead of the LED box.
- Compare the separation distances.
- What are some issues with communicating this way?
Communication with Light

- Try using the bike lights
  - There are numerous light patterns to try

- What effects do you see or hear?

- When would you want to have interference?

- When do we not want interference?
The Future

• Together, **WE** can inspire and excite students in science, technology, engineering and math.

• Together, **WE** can make the change.

• Together, **WE** hold the key to the future.

**MATH**
**ENGINEER**
**TECH**
**TECHNOLOGY**
**SCIENTIST**
Next Steps

• NDEP Website – ndep.us
• Local Education Office
• Local Universities
• Local Industries
• Local Professional Societies
• Local City or County Economic Development Councils
• Scouts / Clubs
• Be CREATIVE!
Some thoughts to ponder

▼ “Society gets what it celebrates”
  (Dean Kamen)

▼ “Unless someone like you cares a whole awful lot, nothing is going to get better, it’s not.”
  (Dr. Seuss’ Lorax)
Questions

??????
Science Research

Getting Outside
Science Research

Getting Up
Science Research

Getting Wet
Science Research

Getting Under