Communicating the Excitement of CS: K-12 Outreach Practices

• Eric Grimson (MIT)
• Marc Snir (UIUC)
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Setting the stage

• National decline in student interest in CS
  – Yet need for CS graduates is growing
• Losing ground to other engineering disciplines
• Problem is particularly acute for women and underrepresented minorities
• How can we counter trends and rekindle student interest in field before they get to college?
Figure 1. Newly Declared CS Majors
Source: CRA Taulbee Survey

Total, left scale

Median per dept., right scale

CRA: Jay Vegso
Causes

- Image of field
- Misperception of job prospects
- Misperception of career opportunities
- Lack of role models
- Losing students early in process
Women’s Technology Program

Sparking high school girls’ interest in the fields of engineering and computer science
WTP was started in 2002 by MIT EECS students. Why?

- Despite a 42% female MIT undergraduate population, EECS had only 20%

- Nationwide, the percent and number of women earning CS Bachelor’s degrees had been in decline since the early 1990’s

- Most high school girls with very high SAT math and science scores were still not choosing engineering majors, or applying to colleges with engineering departments.
Pipeline Issues: Jane Margolis and Allan Fisher, Carnegie-Mellon
“Unlocking the Clubhouse: Women in Computing”

• negative stereotypes about the field
• lack of female role models
• lack of pre-college computing/engineering experience creates lack of confidence in EECS aptitude and ability

WTP Goal:
• reach girls with demonstrated math and science talent
• before they make decisions about college and majors
• give them a taste of engineering and computers that will dispel the negative pipeline issues
What is the WTP?

• Hands-On Courses
  - Computer Science
  - Electrical Engineering
  - Discrete Math

• Female MIT student staff

• Projects: Motor Building (Prof. Steve Leeb)

• Faculty & Industry Guest Speakers, Lab Tours

• Residential 4-week summer experience:
  - teamwork, problem-solving, informal learning, friends

EECS is fun!
Computer Science

...thinking like a computer scientist

Athena, Unix,
Java Programming

Arrays
Algorithms
Recursion
Debugging
Problem Solving
Final projects:
  Sketch Recognition
  Uno-bots, GUs
Electrical Engineering

Current and Voltage
Circuits and Components
Digital Logic
Waveforms, Capacitance
Inductors & Filters
Diodes, Transistors, Op-amps
Projects:
   AM Radio
   LED Jewelry
   Random number generator
Discrete Math

Numbering systems
Binary Logic
Logic Proofs
Probability
Combinatorics
Algorithms
Proof by Induction and Recursion
Matrix Math
Student Presentations
Motor Building
WTP Staff (all female):

PhD students
3 Course Instructors (EE, CS, Math)
1 Residential Director

Undergraduate students
9 Residential Tutors (3 each EE, CS, Math)
2 Residential Assistants (WTP alums/MIT frosh)

Director
Cynthia Skier, MIT alumna SB ’74, SM ‘81
MIT Faculty Guest Speakers  2002-2005

Regina Barzilay
Eric Demaine
Mildred Dresselhaus
Polina Golland
Linda Griffith
Eric Grimson
Hugh Herr
Judy Hoyt

Leslie Kaelbling
Manoli Kellis
Steven Leeb
Nancy Lynch
Daniela Rus
Joel Voldman
Victor Zue

Various EECS graduate students
Lab Tours:  MTL fab, Broad Institute, 3D Optics, RLE BioMems
Funding Sources

• WTP student fees ($3,000 but waive for 30%)
• EECS Department
• Dean of Engineering
• Individual Alumni Donors
• Corporate Sponsors
Impact and Success: Short-term

Intake and Exit Surveys 2005:

• Increased interest in Engineering and CS majors
  - Engineering: 38% to 51%  CS: 9% to 17%

• Increased confidence in ability in EECS
  - EE: 55% increase  CS: 85% increase
Impact and Success: Short-term

Intake and Exit Surveys 2005:

- Change in attitudes towards EECS
  - 88%: perception MORE POSITIVE after WTP
  - Not working in isolation
  - Benefits humanity
  - Not just for “nerds”
  - Offers good job opportunities
Impact and Success: Long Term

WTP alumnae affirm the lasting impact of WTP on their current college pursuits and on their plans for the future.

Before WTP many would not have:
- Majored in engineering or computer science
- Applied to an engineering college
- Considered applying to MIT
Statistics

• **Alumnae Summary Statistics as of 2008**
  – 266 students have attended WTP-EECS over five summers
  – The 40 summer 2008 students are currently seniors in high school, in the process of applying to college.
  – Of the 226 old enough for college, 97 came to MIT (43%) -- 72 are currently attending, and 25 completed the SB degree
  – 24 of the students are at Harvard
  – 45 went to Stanford, Yale, Princeton, UPENN, Georgia Tech, Columbia, Cornell, Cal Tech, or Carnegie-Mellon
• Declared Majors of the 177 college sophomores, juniors, seniors and Bachelor’s Degree graduates:
  – 95 are majoring in a field of engineering or computer science (54%)
    • 56 are EE, CS, Artificial Intelligence, Operations Research or Applied Math majors (32%)
  – 18 are Mechanical Engineering majors (10%)
  – 47 are majoring in science or theoretical math (26%) -- many of these are pre-med
  – 18 are majoring in management or economics (10%)
  – 17 are majoring in humanities or architecture (5%)
  – 49 are unknown or undecided

• Of the 97 students at MIT:
  – 12 will enter as freshmen
  – 56 of the 83 with declared MIT majors are in one of the engineering departments at MIT (67%)
    • 25 are MIT EECS Course 6 majors; 15 are MIT Mechanical Engineering Course 2 majors
Why students choose MIT

“Before WTP I was unsure about what kinds of students went to MIT, and I was worried that I would not fit in and wasn’t smart enough... being at WTP convinced me there are plenty of people that I can relate to, and that I will not be at the bottom of the class.”

“WTP made my freshman year much easier, because I was already familiar with campus, and had a great group of friends.”

“WTP gave me the confidence I needed to convince myself that I could succeed in an engineering discipline... [and this helped me] search for research opportunities (UROPs).”
How WTP influenced their majors:

“My major is Course 6, to which I was first introduced at WTP, otherwise I don’t know if I would have really considered it.”

“The hands-on projects made me realize that I should pursue engineering.”

“WTP definitely influenced my decision to choose EE... it was inspiring to learn about all of the creative applications it has, from the guest lectures we attended.”

“I wasn’t originally planning to go into any sort of science field, but the lectures on AI... sparked my interest in neuroscience. Having done WTP gave me the confidence to apply for a programming job this summer at my school’s [Oberlin’s] Computational Biomathematics Lab, and I got it!”
Impact

• “My experience at WTP definitely gave me confidence to apply to more top-tier schools. Because of the experience in EECS during WTP I’ve decided to go into Course 6 at MIT. Experimenting in EECS for a full month definitely boosted my confidence.” Jessica Sundberg, Yardley, PA, WTP 2003, MIT Freshman Class of 2008.

• “The positive experience I had at WTP greatly influenced my decision to attend MIT. The motor building workshop was awesome.” Andrea Greb, Rochester Hills, MI, WTP 2003, MIT Freshman Class of 2008.

• “Even more important than the information I took in during class was the spirit of innovation that abounded. We were encouraged to find new approaches, and saw professors researching at that very moment.” Elena Glassman, Pipersville, PA, WTP 2002, MIT Freshman Class of 2008, 2003 Intel International Science and Engineering Fair Young Scientist Award winner.
Women’s Technology Program

http://wtp.mit.edu