

Meeting ETIC's Goals: Recommendations for Pre-College Preparation

Oregon Pre-engineering and Applied Science (OPAS) Committees

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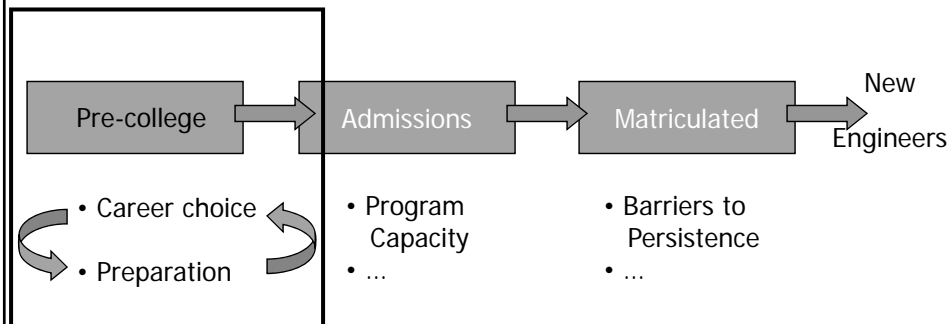
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February 8, 2008

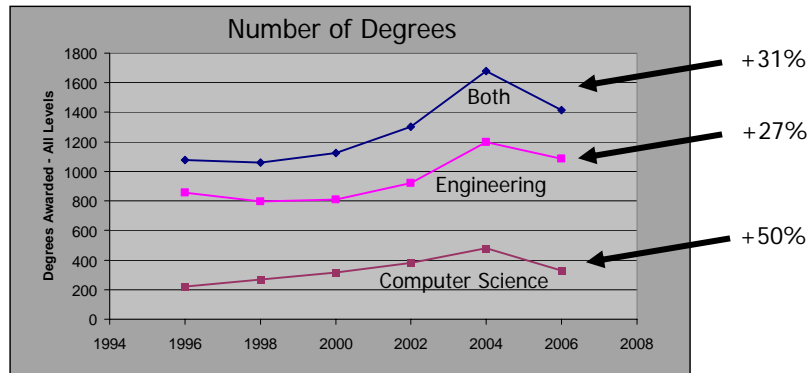
Pre-College Programs: Keys to Preparation and Choice



A Snap Shot of Progress

OUS Degrees Granted 1996-2006

Note: All OUS degrees increased by 37% in this period



Mix:	Bachelors	75%
	Masters	22%
	Ph.D.	3%

Source: OUS Data Book 1996-2006

Request to ETIC

Launch a 6 year transformation of pre-college education by investing \$4.5M/biennium to bring engineering and computer science to all students


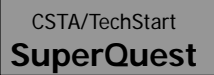
- **In Class Programs:** expand opportunities to explore careers and master skills through rigorous pre-engineering and computer science classes
- **Out of School Time Programs:** expand clubs, challenge events, and internships (for students and teachers) with special focus on underrepresented students.

Goal: Over 50,000 Oregon students per year will participate in pre-engineering and computer science programs

Oregon Opportunity: Increase Pre-college Exposure to Engineering

		Teachers	4-8	9-12
In Class Programs	Strategy <ul style="list-style-type: none"> ▪ Build on proven successes ▪ Address critical pre-college gaps ▪ System-wide expansion of opportunities 			
	 Extend national exemplar pre-engineering program to high schools and middle schools statewide (OIT is current OUS host university)	X	X	X
	 Expand access to computer science by building on collaboration created by Oregon Computer Science Teachers Assoc. and the Software Association of Oregon	X	X	X
Out of School Time Programs	Expand proven programs addressing minority/under-represented through collaborative team projects: ORTOP, SMILE (OSU), MESA (PSU), 4-H Tech Wizards, and similar high potential new programs	X	X	X
	Seed engineering challenge programs which create exciting opportunities for advanced projects, mentoring, and scholarships	X	X	
	Create summer internships for teachers and high potential students in industry and universities	X	X	
Marketing	Focus state-wide communications/marketing to students, parents, teachers and counselors on STEM education and career paths	X	X	X


A Program for Change

Approach	<ul style="list-style-type: none"> ▪ Implement over 6 years ▪ Sustainable, system wide change ▪ Measurable impact on pipeline 	Students Impacted* (6th year goal)	Cost in Initial Biennium
 Accelerate adoption of pre-engineering classes	<ul style="list-style-type: none"> ▪ 64 new programs within 2 years ▪ Programs in 75% of schools within 6 years ▪ Increase qualified applications to OUS Engineering/CS programs 	20,000	\$1.3 M
 CSTA/TechStart SuperQuest		12,000	\$0.7 M
Expand proven programs addressing minority/under-represented	Double number of students reached by high quality programs	10,000	\$1.4 M
Launch team challenges program modeled after high school athletics	Challenge kits, s/w and tutorials for engineering teams. Extra duty stipend matching grants for Engineering Coaches at 30 schools	3,000	\$0.6 M
Establish teacher and high potential student summer internships	Create 10 teacher internships/year and 100 high school internships	9,000	\$0.3 M
Lead state-wide communications/marketing focus in support of student academic preparation, career choice, and university selection		All high school middle school	\$0.2 M
Total		54,000	\$4.5M

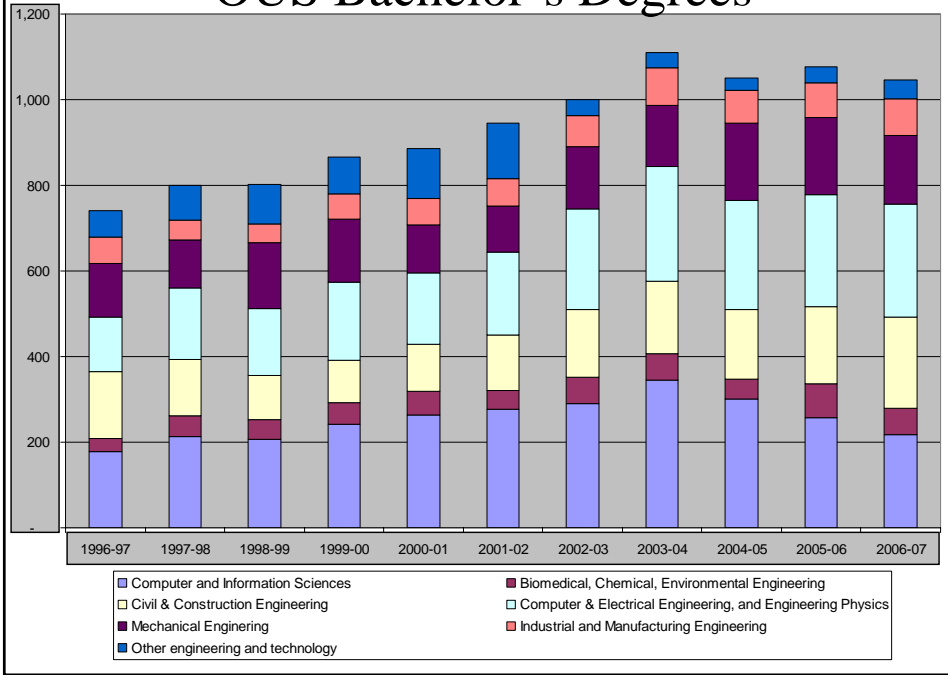
*Students may participate in multiple programs

Supporting Data

A Program for Change

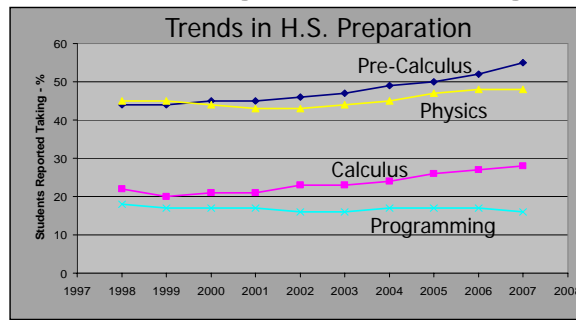
Approach <ul style="list-style-type: none"> ▪ Implement over 5-6 years ▪ Sustainable, system wide change ▪ Measurable impact of pipeline 	Students Impacted* (2ed year goal)	Cost in Initial Biennium
 Accelerate adoption of pre-engineering classes <ul style="list-style-type: none"> ▪ 64 new programs within 2 years ▪ Programs in 75% of schools within 6 years ▪ Increase qualified applications to OUS Engineering/CS programs 	6,000	\$1.3 M
CSTA/TechStart SuperQuest	4,000	\$0.7 M
Expand proven programs addressing minority/under-represented Double number of students reached by high quality programs	6,700	\$1.4 M
Launch team challenges program modeled after high school athletics Challenge kits, s/w and tutorials for engineering teams. Extra duty stipend matching grants for Engineering Coaches at 30 schools	800	\$0.6 M
Establish teacher and high potential student summer internships Create 100 high school internships and 10 teacher internships	3,000	\$0.3 M
Lead state-wide communications/marketing focus in support of student academic preparation, career choice, and university selection	All high school middle school	\$0.2 M
*Students may participate in multiple programs	Total	20,500 \$4.5M

OUS Bachelor's Degrees



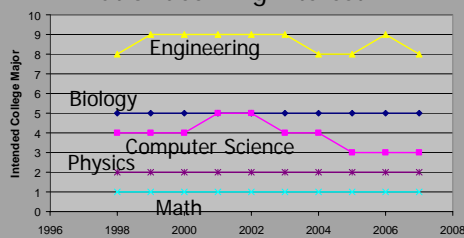
Pre-college Challenges

Academic preparation is improving...

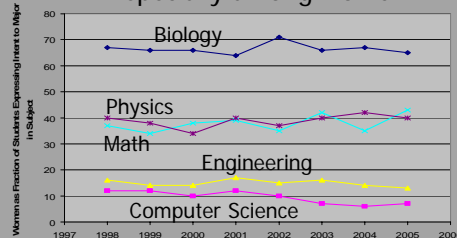


...but career interest is not!

Flat or declining interest ...



... Especially among women



Example of Limited Pre-college Engineering Opportunity

Example:

Oregon public high school students	~170,000
CTE* high school students	74,803
Engineering CTE students	5,165
Number of Oregon high schools	>220
CTE Engineering Programs	33

*CTE is "Career and Technical Education", one of the opportunities to deliver pre-engineering and computer science classes in high schools.

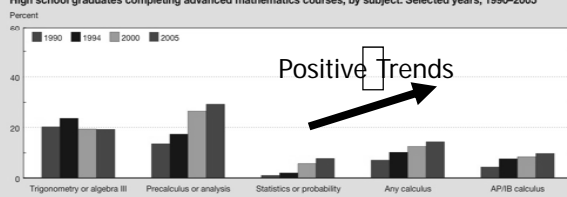
A Window of Opportunity

NSF Indicators for Current High School Programs

Students are better Prepared in math And science ...

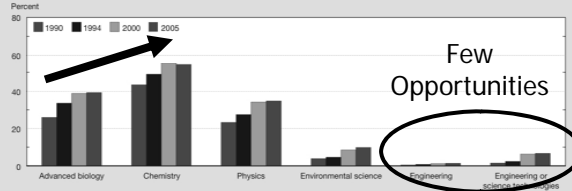


Figure 1-5 High school graduates completing advanced mathematics courses, by subject: Selected years, 1990-2005



AP - Advanced Placement; IB - International Baccalaureate.
 SOURCES: National Center for Education Statistics, National Assessment of Educational Progress, 1990, 1994, 2000, and 2005 High School Transcript Studies; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 1-9.
 Science and Engineering Indicators 2008

Figure 1-6 High school graduates completing advanced S&E courses, by subject: Selected years, 1990-2005



SOURCES: National Center for Education Statistics, National Assessment of Educational Progress, 1990, 1994, 2000, and 2005 High School Transcript Studies; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 1-10.
 Science and Engineering Indicators 2008

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 ...but have few opportunities for Early engineering classes or experience.

Project Lead the Way

“The project has developed a 4-year sequence of courses that, when combined with college preparatory mathematics and science, introduces students to the scope, rigor, and discipline of engineering and engineering technology.

Students participating in PLTW courses are better prepared for college engineering programs than those exposed only to the more traditional curricula.”

Rising Above the Gathering Storm
The National Academies
pages 128-129

Project Lead the Way Profile

“Project Lead The Way is all about teaching and learning. The hands-on, project and problem-based PLTW approach adds rigor to traditional technical programs and relevance to traditional academics”

High School Biomedical Sciences

- Principles of Biomedical Sciences
- Human Body Systems
- Medical Intervention
- Scientific Research

High School Engineering

- Intro to Engineering
- Principles of Engineering
- Digital Electronics
Civil, CIM
- Capstone: Engineering Design
And Development
- Plus: Aerospace, Biotechnical,

Middle School Technology

- Gateway to Technology
 - Magic of Electrons
 - Science of Technology
 - Automation and Robotics
 - Flight and Space

PLTW 's curricula make math and science relevant for students. By engaging in hands-on, real-world projects, students understand how the skills they are learning in the classroom can be applied in everyday life. This approach is called activities-based learning, project-based learning, and problem-based learning (or APPB-learning, for short). Research shows that schools practicing APPB-learning experience an increase in student motivation, cooperative learning skills, higher-order thinking, and student achievement.

Student Internships

- **What:** Internships in technical fields (CS, MechE, IT, Software Eng, Computer Hardware, Physics, EE, ChemE, Optics & Signaling, BioTech, Civil); mainly corporate, some research
- **Rationale:** Important to motivate students all along the pipeline and close the deal with the best students; students will be well prepared because of work in PLTW & competitions
- **Metrics:** 75% will declare major in same field upon entering college
- **Number of students:** 100
- **Cost:** \$220,000 (\$7/hr/student) (320 "contact hours"/student)
- **Match:** \$100,000 (student stipends paid by companies)
- **Sustainability:** Transition companies to cover more costs as they experience successes; costs per student decline the more companies participate

Educator Internships

- What:** Provide K-12 teachers with first-hand knowledge of the business workplace through summer internships
- Rationale:** 1) improved curriculum that makes learning relevant to students—math science and technology studies linked to "real world;" 2) teachers are more prepared to excite students about engineering/ technical professions and provide career guidance.
- Cost:** \$25,000 (\$2,500/educator; 10 educators per year)
- Match:** \$25,000 (business contribution)
- Number of students:** Highly leveraged investment—each teacher reaches ~150 students/yr. Multiplier effect year over year (1,500 students in Year 1; 3,000 in Year 2 . . .)
- Research:** Reporting on teacher internships, Columbia University validates the "significant positive impact on their student's interest and achievement in science"

Engineer Challenge Program

- **Goal:** Create an OST Engineering program that becomes as successful as the current athletics/sports programs
- **How:** Provide matching "extra duty stipends" to High Schools to hire after school Engineering Coaches to draft and coach FTC engineering teams
- **Rationale:** Develop engineering faculty champions while increasing student contact hours, engineering visibility, and recognition of student engineering achievement
- **Metrics:** 25 (out of 30) High Schools will assume full funding of engineering coaches in year 2011, 70% of students receiving "Engineering Letters" will pursue engineering studies in college
- **Number of students:** 450 (30 schools, 15 students/school, 175 contact hrs/student)
- **Cost:** Stipends \$150,000/year (\$5K for 30 Schools), Materials: \$90,000/year First Tech Challenge Kits for 30 schools
- **Match:** Schools match \$150,000 Extra duty stipends (10K stipend for Engineering Coaches at a given school)
- **Sustainability:** Schools commit to 75% funding 2nd year and 100% funding following 2 years

Engineer Challenge Details

- Team competes in organized events, such as FTC, MIT InvenTeam, PDX BOT, Electrothon, Robothon
- Students could earn a letter in engineering
- Scholarship opportunities for outstanding engineering students
- Head Engineering coach becomes a local champion for engineering
- Brings focus and importance of engineering to the whole school
- Develops parent/community support organizations
- Feeds College Engineering Programs
- Extra Duty Stipend of \$6-12K based on Head Football Coach stipend
- Coaches can be recruited from outside current faculty pool, as with athletic coaches, teaching accreditation is not required
- Engineering coaching staff expected to expand to include assistant coaches for specialized areas (software engineering, mechanical design)
- Expect one week summer engineering camps to become popular

First Tech Challenge

- **Goal:** Duplicate success of FLL at High School level
- **How:** Model challenge more on FLL and less on FRC - some early ideas:
 - Yearly challenge tied to current world issue to show human value of engineering
 - Increase Autonomous competition element, consider eliminating remote control element
 - Add Product Marketing/Business Plan component
 - Require H.S. team to mentor/coach FLL team
- **Staffing:** Use extra duty stipends for faculty coaches
- **Metrics:** 30 High Schools and 50 other groups will field FTC teams in year 2010
- **Number of students:** From Coaching program 300, Other groups: 500
- **Cost:** FTC Materials: \$60,000/year - 20 scholarship FTC kits
- **Sustainability:** Industry sponsorships , team fund raising, and admission charges to competitive events to offset costs