

IOWA STATE UNIVERSITY
Program for Women in Science and Engineering
www.pwse.iastate.edu

Changing the Conversation About Engineering

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Recruiting Girls to Engineering

- Awareness – Limited
- Need relevant engineering examples
- Want well paying jobs that make a difference
- Want to create rather than build; discover, design, imagine, innovate and contribute
- Humanize engineering - Relate work to ppl [images] rather than mechanistic things
- Problem solvers essential to health, happiness and safety
- Stop reinforcing engineering as nerdy/boring
- Stop focusing on math & science inputs rather outputs career opportunities, make a difference



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Changing the Conversation - Operationalized

FREE Purpose: To support groups of academically-able young women to think seriously about engineering as a career. To follow the course of their career decision making over time.

Female Recruits Explore Engineering

Context: Researchers and high-achieving female students from Colorado, Iowa, and Ohio.

Methodology: Participatory action research and case study research

FREE - Socio-economic (n=132)

FREE - Ethnicity (n=132)

FREE - Geographic

Research Questions & Preliminary Findings:

Our results suggest that many high-achieving girls know little or nothing about engineering. Thus, they really can't develop an interest in it or choose it. Theoretically they are free to choose, but their "choices" is empty.

Research Questions

- What do high school girls want to know about engineering?
- How does the prospect of engineering fit into the context of the girls' lives?
- How do racial, socio-economic, and multicultural perceptions on engineering?
- How and why do young women's interests in engineering change over time?

Preliminary Findings

Not hard to get girls interested in engineering activities. Were surprised at the different types and contexts of engineering. Interested in the benefits of engineering to self and others. Concerns about engineering surfaced (questions about time, stress, women in the field, particular requirements).

Most of the girls knew little about engineering when FREE began and very few were planning to pursue engineering (see table below). Engineering did not fit easily into girls' lives. The FREE project was difficult to fit into their busy schedules. The girls:

- saw engineering as a largely male domain
- were concerned that the practice of engineering may be incompatible with future family lives.

Lower socio-economic class minority girls had more difficulty seeing engineering into their lives than middle class white girls. Pursuing engineering in college or a career was more than a matter of being interested. The girls in FREE lacked other resources making it difficult to pursue even with interest. Lack of role models, mentors and communities of practice. Lack of knowledge about college. Fear of what college will bring. Immigration status. Lack of economic resources.

Once exposed to interesting aspects of engineering, interest grows, even to the point of expressing a desire to pursue engineering in college (see table below). After exposure to engineering, the girls began to name more styles of engineering, identify more characteristics, and express more personal interest.

Data Collection:

FREE Activities Timeline Sample

Girls' Trajectories of Interest in Engineering Over Time

Start	Continue'd Eng at Start	Returned Again	Continue'd Eng Aug 08	Stay in Eng Aug 08	Stay in Eng Aug 09	Switch Eng - NE Eng	Switch Eng - NE Eng
CO	69	18 (22%)	28 (35%)	15 (19%)	8 (10%)	19 (24%)	4 (5%)
IA	46	12 (26%)	21 (46% & 36%*)	10 (44%)	7 (32%)	1 (5%)	2 (9%)
OH	20	2 (10%)	15 (75%)	12 (60%)	2 (10%)	3 (15%)	10 (50%)
TX	131	31 (24%)	34 (26%)	37 (28%)	15 (12%)	22 (17%)	14 (11%)

Recommendations:

- We most proactively provide contexts in which engineering and other STEM related interests can be developed, supported, and nurtured.
- Cultivate communities of practice to support career exploration and influence vocational development.
- Programs like FREE that provide sites for engineering practice must be supported and protected.

Research Team: Practitioners, experts and scholars in anthropology, career development and post-secondary education transitions, education, engineering, Latin studies, Native American studies, sociology, curriculum and instructional technology, and women's studies.

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Web-based Virtual Learning Community
Research-proven virtual teams, with data, learning environments created by FREE participants.
data is collected via mobile technology and virtual learning community supported by dedicated servers.
this approach promotes exploration and learning resulting in frequent and spontaneous data.

Engineer Your Life (www.engineeryourlife.org)

Engineer Your Life™ A guide to engineering for high school girls

Why Engineering?
Meet Inspiring Women
Find Your Dream Job
Making It Happen

For Counselors & Parents
For Engineers
For Middle School Girls
(see engineergirl.org)

Why Engineering?
Ten great reasons why you'll love it

- Love your work, AND live your life too!
- Be creative.
- Work with great people.
- Solve problems, design things that matter.
- Never be bored.
- Make a big salary.
- Enjoy job flexibility.
- Travel.
- Make a difference.
- Change the world.

ASK an Engineer! >

What IS an engineer?

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Where ISU students go who leave STEM Top Five Destinations

Women

1. Psychology
2. Elementary Education
3. Marketing
4. Child and Family Services
5. Management

Men

1. Management Information Systems
2. Pre-Business
3. Finance
4. Management
5. Marketing



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Understand That

- **Gender functions like culture** – boys and girls still develop different bodies of **knowledge** and **experience**; are acutely aware of different **societal expectations** and respond to differential **reward structures**.
- Anyone who finds themselves in a situation where they are greatly underrepresented will feel the **weight of representing ‘their kind’** i.e. *stereotype threat*.
- **Women** will generally ascribe difficulty with a task to **internal characteristics** (I’m not smart enough, I am a failure, I can’t learn this because I’m dumb, i.e. *attribution theory*) leading to lower self-confidence and depressed risk-taking.
- Women are strongly attracted to activities/careers that have a direct link to **practical application and ‘helping’ others**.
- Young women will ‘often ‘defer’ to young men when activities involve hands-on group work. This is not a symptom of disinterest but a reinforcement of the reward system they are growing up in (don’t be too aggressive, always be polite and defer to others, you don’t come first)

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Factors influencing women in STEM

- **Student Behavior**
- **Attitudes and Aspirations**
- **Academic Preparation**
- **Pre-College Education**
 - **Curriculum/Instruction**
 - **Teachers/Counselors/Peers**
 - **Learning Opportunities**
- **Family/Environmental Support**
- **Role Models**
- **Post Secondary**
 - **Structure and commitment**
 - **Academic & social climates**
 - **Special programs**



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Strategies

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Recruitment Models of Success

- Messaging is important – impact on world/society
- Hands-on, interactive, multiple contacts
- Building self-esteem, confidence
- Role models – developing connections
- Family involvement
- Creating awareness, seeing possibilities



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PWSE K-12 Needs Assessment

- Input from educators, parents, and 6-12 grade girls
- A few key findings:
 - Girls are least interested in learning about careers on-line
 - Girls have higher interest than participation in STEM related programming
 - Competing with athletics and music – top ‘extra curricular’ programming
 - Students confidence in STEM drops during high school
 - Parents and educators are not aware of resources available
 - Need more role models for girls
 - Many were interested in STEM summer camps
 - Weekend programming is least desired by students



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Retention Models of Success

- Building community of support
- Mentoring (professionals, alumni, peers, etc.)
- Engagement of students: leadership, UG research, experiential learning, job shadowing, student organizations, etc.
- Study groups
- Setting realistic expectations, self-confidence
- Approachable, engaged faculty/staff members
- Personal encouragement
- Inclusive learning environment



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Creating an Inclusive Learning Environment

- **Five general recommendations:**
 - Try to balance the curriculum by using units/activities/examples that appeal to men, women, people from different backgrounds, etc.
 - Be aware of differential knowledge and experiential bases of your students.
 - Be intentional in making a direct connection between the skills/ concepts being taught and their practical application and impact on society.
 - Encourage young women to “sign up” in pairs and allow them to work together.
 - Set up competitive situations where the desired outcome is not person against person or one winner vs. losers, but is about coming up with creative solutions to a posed problem. This allows for many different endpoints and provides students with the opportunity to use their own knowledge and experience to develop creative solutions.
- **Tips for Engineering Classrooms:**
 - Participation
 - Leadership
 - Community
 - Brochure with 10 tips in each area -- will post on SharePoint

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Additional Resources

- **Engineer Your Life** www.engineeryourlife.org
- **WEPAN Knowledge Center**
www.wepanknowledgecenter.org
- **CASEE – New Directions in Engineering Education booklets: career awareness, retention, advancement – of women in engineering** www.caseeconduit.org
- **Program for Women in Science and Engineering**
www.pwse.iastate.edu
- **“Report to Iowa Legislature on Women and Minorities in STEM fields at Iowa’s Public Universities”, January 2009**
www.iowamathscience.org/reports
- **Equitable Classroom Practices Institute, Rice University**
www-bioc.rice.edu/precollege/ei/best_practices.html

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