

## On CBE Women and on how we developed W.O.M.E.N. at Cornell University

### The Facts

Although significant progress has been made over the last few decades, the percentage of women in top-notch positions in STEM today is still far from ideal. In 2007, Chem. & Eng. News reported that the percentage of women holding corporate officer positions in chemical companies is ~10% out of nearly 400 positions surveyed. Across top academic research institutions in the sciences, female faculty represent only 10-15%. This occurs despite a large number of females in the pipeline. We have a high average enrollment of female undergraduate students (40%) and graduate enrollment (35%, occasionally topping 50%) at Cornell University, and nearly 50% enrollment of females under 15 years old in K-12 schools.

One possible explanation is the 'sticky floor', which is a self-imposed barrier based on misinformation or incorrect assumptions regarding the ability to excel in top positions that causes women to dismiss their career aspirations.

### Who We Are

The CBE Women's group (at Chemical and Biomolecular Engineering, Cornell University) was reimagined in 2008 to develop those leadership skills and provide opportunities to female graduate students and postdoctoral research associates to empower them so that the sticky floor is no longer an issue. We organize events and programs nearly every month of the year. Our programs and events broadly cover three main goals of our mission.

### What We Do

First, we promote professional development and fellowship within our department. Some of our monthly events have the goal of relaxing and promoting fellowship. We organize berry picking during Ithaca's gorgeous summer followed up by a dessert social. We also get faculty involved with a wine tasting mixer. Beyond that, we invite experts on fields to conduct workshops with at least a few concrete tips that participants can effectively incorporate to improve our leadership, communication, and people skills. Over the years, we have covered a variety of topics including salary negotiation, tailoring your research statement to a lay audience, branding oneself, finding your voice for public speaking, building a resume, practicing an elevator talk. As an example of the impact of these workshops, one success story stems from the negotiation workshop we held. One particular student in the process of negotiating her first job had, prior to the workshop, asked for a salary between \$70-90K with company X (they offered her the \$70K). After the workshop, she effectively negotiated her next job offer with company Y and was offered a salary of \$90K and relocation expenses, a \$10K signing bonus.

Our second mission is to focus on issues pertinent to female graduate students, postdoctoral fellows, faculty and visitors. We have lunch with invited female seminar speakers and often a very open discussion ensues on their career paths, tough choices they've had to make, and the glass ceilings they've had to face. And sometimes these discussions lead to fruitful tips that one can adopt when faced with such a situation.

Our third mission is to provide mentorship, networking opportunities and opportunities for personal growth and leadership. We introduced a peer-mentoring program in our department. Every incoming grad student is paired with an older student to ask questions about adjusting to grad life and to provide some guidance in advisor selection and in submitting fellowship applications. We also have professors mentoring graduate students and postdocs. And, to complete the loop, our alumnae in industry and academia also interact with our students and postdocs giving back valuable advice. We invited alumnae from the industry and academia for a day-long panel discussion in 2012. It provided the students an opportunity to network with all our alumnae and empowered our younger alumnae to stay connected through these kinds of programs.

### **Pilot Program**

Our biggest annual event is the W.O.M.E.N. outreach event, an acronym for Women's Outreach in Materials, Energy and Nanobiotechnology aimed at sophomore high school students and highlighting the three main aspects of chemical engineering. The idea came from one of our graduate students who said "Let's start an outreach program for 10<sup>th</sup> grade girls". The main focus was to target rural schools in upstate NY, since they may have fewer opportunities than urban students, and because Cornell is located in a rural area. We felt it was important not just to get the children excited, but the parents also, so that they could continue to reinforce the positive image of science with their children and the opportunities it can afford. Recognizing that some of the parents may have minimal education themselves, we strive to include them in the outreach event to teach them about college life, career opportunities for their daughters, and connect science and our research to societal benefit.

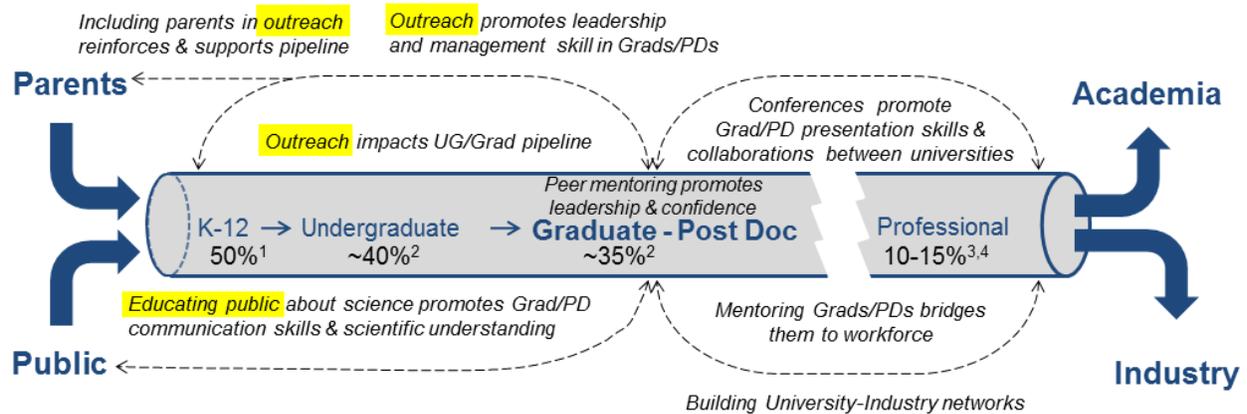


Figure 1: Ways in which CBE Women promotes the presence of women in the pipeline of scientific workforce. Shaded in yellow are the specific contributions of the outreach program W.O.M.E.N.

With this mission in mind, our main goal is to increase the visibility of engineering and to enable young girls to seriously consider a career in engineering. High school sophomore students and one parent of each are invited for a day-long event. In the morning, the students are led to labs and demonstrations, one each in materials, energy and nanobiotech. At the same time, we have sessions tailored to parents to give them a broad overview of career options in engineering, on how to apply to universities, and about financial aid resources. At lunch, all participants and volunteers mingle during a visit to a dining hall to give them a flavor of campus life. Parents and students interact in an informal setting with undergrad students, grad students and faculty volunteers and have an opportunity to ask more specific questions. In the afternoon, we go back to the department and this time we have a buddy lab. Parents and students work and learn *together* while doing science experiments. Finally, we close with a student panel, some desserts and coffee and, weather permitting, a campus tour for enthusiastic participants.

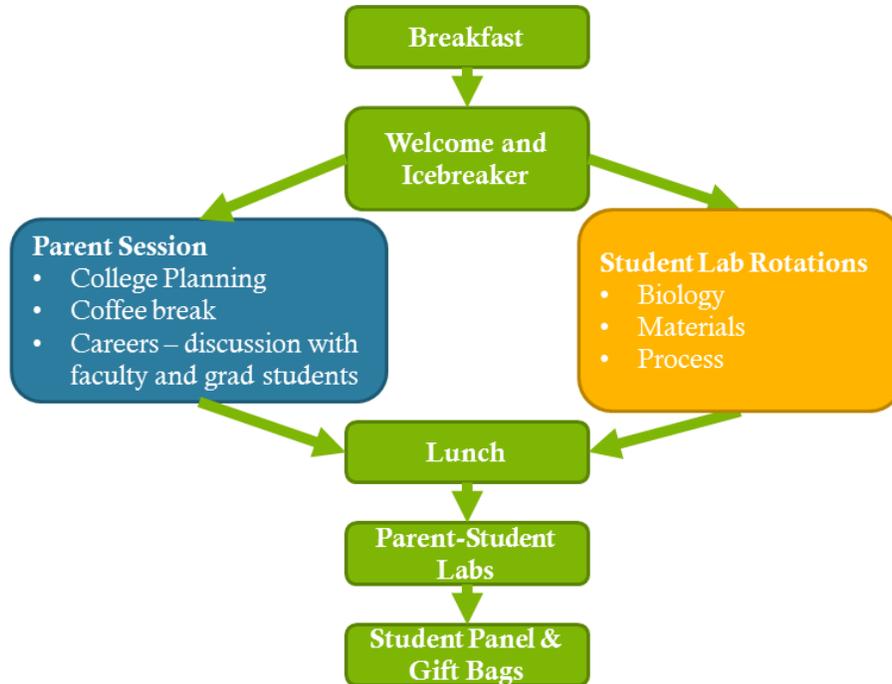


Figure 2: Most recent event flowchart

From the year it started, this program has been an enormous success (Figure 3). That students really enjoyed the event is reflected in over 80% of students saying they would attend a similar event again. A similarly high percentage of girls said they would seriously consider a career in engineering. Based on our initial success, we were able to scale up our event, both in securing funding and recruiting more volunteers. We increased the size of our participant pool to about 50 and reached out to more schools farther from Ithaca (some parents drive nearly three hours to get to the event). Similarly, an overwhelming number of parents said they would attend another event of this kind, and even encourage their daughter to take more science and math courses in high school.

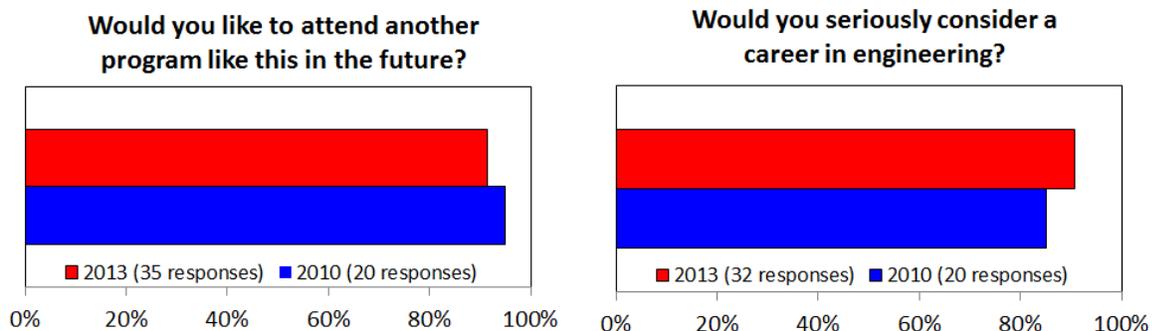


Figure 3: Student feedback for 2010 and 2013.

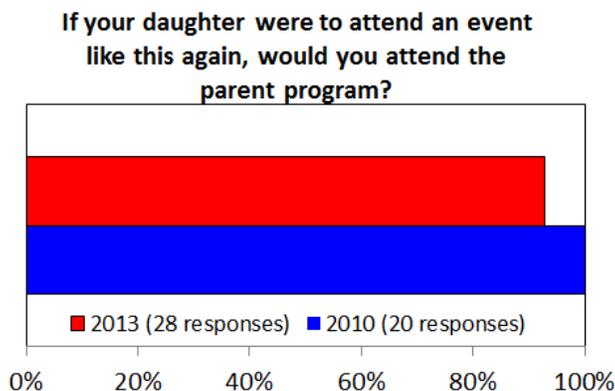


Figure 4: Parent feedback for 2010 and 2013.

Over the years, this program has been reshaped, new experiments designed, modules added and deleted and most of this has been based on feedback that is collected from the participants. For instance, during the initial years, only students did the labs and the afternoon session was very short consisting of the panel discussion and a closing address. Some parents requested an opportunity to do experiments with their daughters and subsequently we expanded the afternoon session and included the buddy labs. In 2011 (first year of implementing buddy labs), one parent wrote, “It was a great way for us to interact. Even though my daughter sees me in many roles, she hasn’t seen my passion for the sciences. Now I can encourage her in areas where she excels.” A student wrote, “It’s nice because you can teach your parent. I thought it was fun and really cool stuff to do.”

## Modules

Here is a list of sample experiments done in each of our lab modules. Often, we change these and include new ones.

1. Chemical processes, making perfume and lip balm



In this module, students make perfume by extracting fragrances from various natural substances using oil and ethanol. They also make lip balms to protect lips from moisture loss from simple

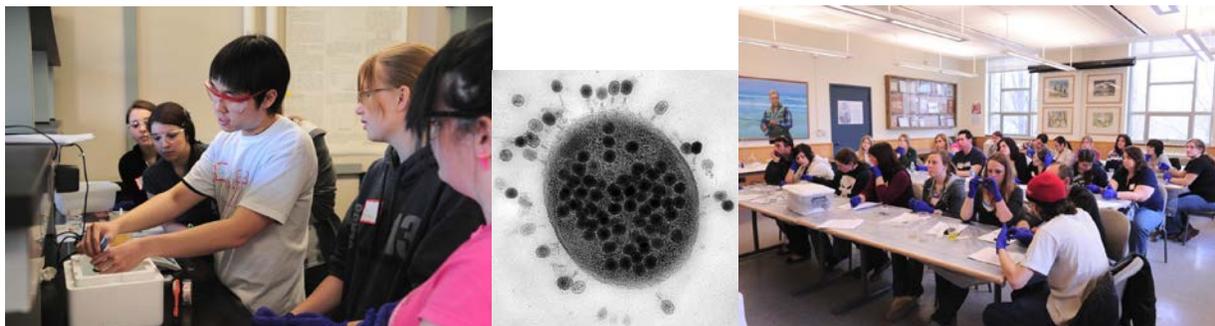
ingredients. The emphasis of the lab is to learn how these are scaled up and what different processing technologies need to be used.

## 2. Materials lab – polymers and complex fluids



In this module, students make three materials with different applications. First, they create non-Newtonian fluids and learn about the consequences of shear-thickening properties, for example, in body armor applications. Second they form hydrogels to study viscoelasticity and its applications in tissue engineering. Third, they make super-absorbant polymers for oil clean-up applications.

## 3. Nanobiotechnology and drug delivery



Concepts of diffusion and controlled release of material are covered in the first experiment where students study how food color travels in a gel made from agar solution. In the second experiment, they learn about how viruses can be used to target cells to treat diseases. In the third experiment, students extract DNA from banana and the basic processing steps are explained.

## 4. Buddy Lab I – surface forces

The consequences of surface tension are demonstrated in this lab, in particular, how objects denser than water can float in water, and how we can make it sink by adding a detergent (soap)

and decreasing surface tension (Movie 1). A second one explains why surface structure affects surface forces. The surface of a rose petal is cast onto a PDMS surface. It is shown that by surface structure alone, a drop of water can stick to the surface and counter the force by gravity. A flat surface of PDMS on the other hand, cannot support a droplet of water against gravity. Thus, in this case, the surface property, not the material property determines the force acting (Movie 2).

## Parent program



## Impact

Perhaps a bigger success of the outreach is the development and opportunities it directly provides graduate students and postdoc fellows. The lab groups come up with experiment ideas, develop the syllabuses, test the feasibility, acquire materials, and design each of the lab modules. It teaches them to communicate and educate the public about science and career options, develop presentation skills, come up with innovative ideas, to use various educational tools, and to mentor young women as role models. In the buddy lab, graduate students, Victoria Sorg and Christian Aponte, incorporated the use of i-clickers to involve both parents and students and to ask a science question before the experiment, then conduct the experiment to demonstrate a non-intuitive concept and finally, reinforce the result using the data collected from the i-clicker. The event creates opportunities for students to develop their teaching statements. Students think about what survey data they would like to collect. Several graduate students who developed buddy labs had the opportunity to present them at a national conference.

Another mentorship role assumed by CBE Women is in recruiting volunteers and engaging undergraduate students in chemical engineering that are also part of the pipeline. Organizational skills like event planning, managing budgets, and delegating tasks are all developed. As the event has grown in size and so have budgetary requirements, students have actively played a part in advertising, writing reports, applying for funding from the campus-wide resource and working with faculty in writing grants. One student said, “Doing outreach activities has not only helped

me **develop professional skills**, but has given me joy in sharing an important part of my world with the younger generations”.

CBE Women thus develops its women graduate students and postdocs by developing the W.O.M.E.N. program. The group received the 2011 College of Engineering Alumni Association Award for Student Group Leadership for its efforts. We gratefully acknowledge funding support from Genentech, the School of Chemical and Biomolecular Engineering, Graduate and Professional Students Assembly Finance Commission at Cornell and help from support staff at CBE. We take pride in our outreach event and value feedback to incorporate new features to our program.

Website: <https://cbegwg.cbe.cornell.edu/outreach.html>

Authors: Poornima Padmanabhan and Susan Daniel

References:

1. From US census information, under 15 years old: 1.04 male(s)/female.
2. Since 2003, female UG enrollment in Chem. Eng. at Cornell has averaged 40% and graduate enrollment has averaged 35% (occasionally above 50%!).
3. Across top academic research institutions in the sciences, female faculty represent only 10 – 15%.
4. In 2007, *Chem. & Eng. News* reported that the percentage of women holding corporate officer positions in chemical companies is ~10% out of nearly 400 positions surveyed.