

The BIOTECH

Volume 6, Issue 1

BIOLOGICAL ENGINEERING-BIOMEDICAL ENGINEERING SOCIETY

Medical School or Grad School?

By **Ying Chan '10**

FEATURES EDITOR

And **Leigh Casadaban '10**

MANAGING EDITOR

"Since I was 12-years-old, I dreamed of the day I would receive my Medical School Admissions Letter," Senior Gina Fridley said. "Thus, I could never have imagined declining enrollment at my first choice medical school, or how emotionally difficult it was to make that choice. It was the hardest decision of my life, but I knew that rationally, I would be happier attending graduate school instead of medical school."

Because of MIT's strong focus on research, the decision of whether to go to Medical School or Graduate School often looms above many pre-medical students, especially in Course 20. According to a recent poll for course 20 undergraduates, 47 out of 84 students are considering a career in medicine. Also, 21 out of 84 students indicated both

graduate school and medical school as possible paths after MIT. As in the case with Gina, the choice can be agonizing and long.

"I realized in the fall of my senior year, while submitting secondary medical school applications, that I was miserable completing them," said Gina. "I was, in fact, just mindlessly doing them. In the mean time, several of my friends were applying to graduate school, and since I was so unhappy I decided, kind of on a whim, to apply as well. So the next week, I took the GREs, and found a renewed enthusiasm for my future."

"I had wanted to be a doctor for 10 years, but I was also excited by research, which is why I intended to pursue an MD/PhD. Later I realized that I really only wanted to do medically-relevant research, and not forever try to balance a life in the clinic, a life in the lab, and a life at home with family. Eventhough the MD/PhD would help me gain both the perspec

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Dr. Isaacson discusses MD career paths at the BE-BMES special pre-med advising event, in March.

"21 out of 84 undergraduates in Course 20 indicated both graduate school and medical school as possible paths after MIT."

New BE Undergraduate Board

By **Mike Yee '08**

FEATURES EDITOR

And **Maryelise Cieslewicz '10**

ASSISTANT EDITOR

In the spring of 2007, the undergraduate program in Biological Engineering lay in its infancy. The fledgling major had just been granted a course number, but it still lacked a lounge, or even students in their senior year. That the juniors and newly-minted sophomores in Course 20 had not yet formed an organization to represent their interests should come as no surprise.

Fortunately, the graduate students had a well-established board, which was willing to help set up an undergraduate equivalent. Graduate students, Amy Nichols and Sean Aidan Clarke, were instrumental in providing the guidance necessary for the genesis of an independent Biological Engineering Undergraduate Board (BEUB). Since its inception, the BEUB has sought to foster a sense of community within

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The BioTECH

MIT (BIOLOGICAL ENGINEERING)-
BIOMEDICAL ENGINEERING
SOCIETY PUBLICATION

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The *BioTECH* is a publication by the MIT (Biological Engineering)-Biomedical Engineering Society (BE-BMES) as a vehicle to inform, involve, and mobilize our membership regarding the complex and evolving bioengineering landscape at MIT and nationwide. Founded in Spring 2003, the *BioTECH* has grown from a campus publication to one with wider constituencies, a bridge for inter-chapter relations and a catalyst to spark discussions on the national scene — the BMES Bulletin, for example, printed our *Letter to the Editor* in a full page coverage (p.3) of its summer 2004 issue <http://www.bmes.org/pdf/vol28_2.pdf>.

BEUB Gets New Undergrad Lounge

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the major.

Officially created in the Spring of 2008, BEUB consists of four officer positions, President, Vice President, Treasurer and Secretary, as well as members at large who attend weekly meetings. BEUB has been extremely active in course 20 affairs and works closely with the Undergraduate Administrative Office. In the last

BEUB and the UG Admin office were happy to open the course 20 undergraduate lounge which is home to the BEUB/BE-BMES office space, a tutoring room, couches and tables for lounging and psetting, and our very own microwave, refrigerator, and coffee maker! BEUB is currently working on adding an Athena quick station, motivational and biology posters, and more whiteboards to

BESB Goals and Events

- Course 20 Social Events: Study breaks for Course 20 undergraduates
- Grad School Information Sessions: Info on applying and choosing grad programs specifically for course 20 students
- Internship Information Sessions: Help course 20 students find summer internships
- Associate Advising: Assign juniors with sophomore advising groups to provide advice on classes and course 20 in general.
- Curriculum representatives at faculty meetings
- Put together course 20 gear, i.e. shirts, mugs, UG lounge

Goals of the Undergraduate BE Board

- * To represent the undergraduate's interests to the BE faculty
- * To create a community of students within the major
- * To organize social and academic events for BE undergrads
- * To identify and disseminate resources for choosing courses, finding UROPs, and learning about life (careers/grad school/med school) after MIT

year, BEUB has implemented a course 20 associate advising program, sent undergraduate representatives to course 20 curriculum meetings, and set up tutoring for core course 20 classes. Furthermore, BEUB has hosted internship, medical school and graduate school information sessions. To cultivate a sense of community within the major, BEUB has also held several study breaks featuring snacks from buffalo wings to Ben and Jerry's Vermonsters, and distributed course 20 tshirts. Perhaps you've seen a mooring turtle, clucking dog, or oinking whale around campus! BEUB was thrilled to recently be granted ASA recognition as well.

In the Fall of 2008

the space for use during office hours and tutoring sessions.

BEUB meets weekly on either Monday or Wednesday at 10pm in the student center coffee house. New members are always welcome! Email busybe-board@mit.edu for more information.



Course 20 undergraduates Bernice Huang, Emillienne Repak, and Dawn Spelke show off the newest BE T-Shirts at the T-Shirt Study Break March 17, 2008.

Life After Course 20 at MIT

Class of 2009 gives Graduate School advice for underclassmen

**Quotes Compiled by
Leigh Casadaban '10**
MANAGING EDITOR

Highlights from the Graduate School Information Panel, Tuesday, April 28th, sponsored by the BE Undergraduate Board. Panel featured Course 20 Seniors and MIT Graduate Students.

How should I choose where to apply?

Gina Fridley (University of Washington): "Don't be afraid to email professors. They're usually really excited to hear that you're interested in their research. Personally, I wanted to see if I could start a dialogue with professors whose research seemed interesting. It's not necessary to find a lab when choosing where to apply, because most schools recommend at least one or two rotations for the first year to can make sure you get along with your advisor. For me, I chose to go to the University of Washington because I'm excited to work with these two professors who told me that I can be jointly advised."

Emilienne Repak (École des Neurosciences de Paris): "If you apply to graduate schools in Europe, the application is free, and they pay for you to visit! And, a PhD. is only 3-4 years."

What should I look for in a Graduate School?

Dawn Spelke (University of California Berkeley): "Don't limit yourself to just BE programs, because it doesn't mean the same thing everywhere. There are some schools where it's worth looking at other programs to find what you're really interested in."

How many Graduate Schools should I apply to?

Augusto Tentori (University of California Berkeley): "I applied to too many. I think we were all a

little worried because most of us wanted to go to grad school and each of us had a very strong curriculum. We were afraid of out competing each other, so we all applied to too many."

Advice on taking the GRE:

Mike Lee (University of California Berkeley): "If you know where you want to go ahead of time, you can send your GRE scores to that school after you take them, which saves some money. And, don't spend a summer studying for the GREs. You need, maybe, 3 weeks."

Emmanuel De Los Santos (Caltech): "You should aim to take

the GREs in the fall, around August. The earlier the better."

Emilienne Repak: "It's most important to know the format of the GRE because it's computerized, and may not be what you're used to."

Gina Fridley: "If you get the first few right you track up to the really hard questions where it doesn't matter if you get a couple wrong."

Kristin Bernick (MIT 3rd year): "One thing that will take time to study for is the GRE subject tests. While BE programs don't require

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Class of 2009: Plans after College

Rebecca Adams	Graduate School	MIT (Cambridge, MA)
Kate Broadbent	Graduate School	Harvard (Cambridge, MA)
Monica Crespo	Medical School	Harvard
Saja Fakhraldeen	Graduate School	University of Wisconsin, Madison (Madison, WI)
Gina Fridley	Graduate School in BE	University of Washington (Seattle, WA)
Matt Gethers	Graduate School	Oxford University
Tiffany Guo	NIH Academy - HIV Immunology Research	NIH (Bethesda, MD)
Bryan Hernandez	Traveling	The world
Iny Jhun	Teach For America	San Francisco, CA
Amirah Khan	Medical School	University of Florida, Gainesville FL
Rebecca Kusko	Graduate School in Genetics and Genomics	Boston University (Boston, MA)
Courtney Lane	MD/PhD	UT Southwestern (Dallas, TX)
Michael Lee	Graduate School in BE	Berkeley/UCSF
Arjun Naskar	Teach For America	Oakland, CA
Kat Pak	Graduate School	Harvard (Cambridge, MA)
Emilienne Repak	Graduate School-- Neuroscience	École des Neurosciences de Paris Ile-de-France
Juliana Rotter	US Navy	Yokosuka, Japan
Phillip Samayoa	Graduate School - Systems Biology	UCSD (La Jolla, CA)
Emzo de los Santos	Graduate School in BE	Caltech (Pasadena, CA)
Dawn Spelke	Graduate School	University of California, Berkeley and SF
Jerzy Szablowski	Graduate School in BE	Caltech (Pasadena, CA)
Rob Warden	Graduate School in BE	University of Pennsylvania (Philadelphia, PA)
Sophie Wong	Graduate School in BE	UC Berkeley, Berkeley, CA
Neil Zimmerman	Graduate School in BE	Stanford (Palo Alto, CA)

Life After Course 20 at MIT

Class of 2009 gives Graduate School advice for underclassmen

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it, you may need to take the Math, Biochemistry or Biology subject test for some similar programs. Those can be harder to study for and require more time."

What's the trick to getting in?

Bryan Owens (MIT 2nd year): "You may pay \$160K for an undergraduate education, but in applying to grad school, you're asking your lab to make an even more significant investment in you in both time and money. So, you have to show them you're worth it. You're there to work. But at the same time, it's important to have a little personality, not just be a pure scientist."

Senior Spotlights:

Saja Fakhraldeen:

"I will be joining a PhD program at the University of Wisconsin, Madison's School of Medicine and Public Health. I chose this program because the faculty research areas matched my interests very well. The most difficult part of the graduate school application process was deciding which schools and programs to apply to. I would advise underclassmen to start the application process (take GREs, decide on schools, request letters of recommendation, write personal statements, prepare resume, etc) as early as possible."

Sophie Wong:

"I will be attending UC Berkeley next Fall! I love California, especially the Bay Area. Also, UC Berkeley campus is amazingly diverse and beautiful. I was attracted to the Bioengineering PhD program's flexibility in course work and the interesting research conducted by many professors. The most unexpectedly difficult part was the "matching process". I didn't realize how subjective and professor-student match dependent the application process was. That is something to keep in mind as you explore many universities and research labs. How well do you fit into this professor's lab? For rising seniors and underclassmen, I suggest that you take a lot of BE electives to find out what you are most passionate about! It will help you focus your interests since BE includes so many fields."

Medical School or Grad School?

A Dilemma for the unsure

(Continued from page 1)

tive of a clinician and of a researcher, I began to question how much the four extra years would really help my career, especially considering how much research I could get done in four years. It wasn't until March this year, during a medical school interview, that I had finally de-



After the event, students seek personal advice with Dr. Isaacson, Professor Griffith and Professor Guttag, at the discussion of MD career paths in medicine in March.

ecided medical school was not right for me. The interviews weren't as hard as I had thought, but for me they seemed forced, and I wasn't enjoying them as much as the graduate school interviews. Also, I hit it off better with the grad students than the medical students, and preferred talking to professors about their research rather than medicine."

Likewise, Professor Linda Griffith, Chair of the BE Undergraduate Programs Committee, was a pre-medical student herself until right before her senior year in college, when she decided that she would be

happier doing research.

"Although I had gotten very good pre-med advising, I was exposed to very little information about graduate school until the beginning of my senior year, so only then did I realize the possibilities of a research career path," Professor Griffith said. "In my view, it is good to keep your options open to many different career paths up until your senior year. If you would really love treating patients, then you should absolutely consider becoming a doctor."

To address these medical school/graduate school concerns, the BE-BMES and the BE Undergraduate Board co-sponsored a premedical advising event 7:30 pm, Monday, March 9, in room 4-237. The event, which attracted sixty MIT undergraduates considering medical school, included a discussion of M.D. career paths led by Dr. Keith

Medical School or Grad School

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Isaacson, Medical Director of the Center for Minimally Invasive Gynecologic Surgery at the Newton-Wellesley Hospital.

As a collaborator with many MIT engineers --in Courses 2, 6, 10, and 20--and co-founder of CIMIT, Center for Integrative Medicine and Innovative Technologies, a consortium of teaching hospitals and engineering schools in Boston, Dr. Isaacson enlightened students about the interdisciplinary collaboration between experts in medicine, science, and engineering. Collaborators Professor John Guttag, Course 6, and Professor Linda Griffith, Course 20, joined the discussion to share perspective on how Ph.D.'s participate in solving clinical problems. Also, as a professor at Harvard Medical School, Dr. Isaacson was able to offer advice about the medical school admissions process and provide perspective on career paths in medicine.

"Becoming a doctor is one way to help patients, though one does not necessarily need an M.D. to help improve patient health care," said Dr. Isaacson. "I have collaborated with Professor Guttag to improve detection of heart disease. Now, Professor Griffith and I are working to understand the molecular basis for endometriosis, a condition in women where cells lining the uterus implant in the peritoneal cavity and cause chronic inflammation and fibrosis. Thus, one can take a variety of career paths and still be able to help improve patient care."

For engineering students interested in combining research and medicine, one path is to pursue an M.D./Ph.D. Perhaps by becoming a Medical Scientist, one can be better prepared to translate observations from the clinic to research, and then apply findings to the clinic. According to Dr. Isaacson, though, "Fewer doctors have time to do

both academic research and patient care, and often pick one of the two paths. It's worth considering that it may be more economical to have more collaboration between doctors that treat patients and researchers."

To further help students select careers relating research and medicine, BE-BMES hosted a second discussion of M.D.

career paths with guest lecturer Dr. Richard Lee, Cardiologist at the Brigham and Women's Hospital and a principal investigator on cardiovascular disease research. On May 6, Dr. Lee described how he decided to start his own laboratory after practicing clinical medicine in Cardiology for nine years.

Dr. Lee's personal advice for students is: "You should pursue a PhD if you are fascinated by a basic field and want to master it. However, I don't think a PhD guarantees anyone research success, any more than having an MD guarantees that you'll be a good doctor. I have seen some investigators with only a medical degree do top notch research, and some researchers with MD/PhDs fail at research. Students should just do what they love."

Even once students set their future career goals, they still have considerations to make during their undergraduate career, such as their major. Professor Griffith says, "Bioengineering is a good foundation for doctors, but so is any technical education. That said, undergraduates may want to weigh how an engineering degree, with its additional technical requirements, might influence their GPA."

Nevertheless, 43% of MIT undergraduate applicants for



Dr. Lee discusses his own career path in from medicine into reseach at the second BE-BMES special pre-med advising event, in May.

2008 medical school admission were engineering majors. 25% of the total undergraduate applicant pool were chemical engineering students. In addition to students' choice of major, grades are not everything in the medical admissions process--according to Tamara Menghi, Assistant Director for Pre-professional Advising at MIT. Of MIT's 2008 undergrad medical school applicants, the range of GPA's from denied students (2.6-3.7) overlapped with the range of GPAs from accepted students (3.2-4.0), signaling the importance of extracurricular activities (community service and experience in a hospital, etc.), MCAT scores, and other factors in the admissions process.

For engineering students exploring the option of medical school, Tamara recommends that they visit the Pre-professional Advising Office, sooner better than later. It offers many helpful resources and services, such as premedical advisors, personal statement critiques, interview preparation, and medical school guides to help students build their applications and improve on certain areas. Students can also join the pre-med mailing list by emailing Shanell Littlejohn (slittlejohn@mit.edu) or follow MIT premed on Twitter for the latest announcements and updates.

"Undergraduates may want to weigh how an engineering degree, with its additional technical requirements, might influence their GPA"

“Choosing a Major” Panel

By *Leigh Casadaban '10*
MANAGING EDITOR

BE-BMES hosted the first ever “Choosing a Major” Panel for freshmen interested in “bioengineering,” on Tuesday, March 31. Nearly ninety freshmen from the class of 2012 congregated in Room 1-190 for dinner and discussion about “bioengineering” with a panel of professors and upperclassmen from Courses 2, 3, 6, 7, 10, 20, and 22.

With the rapid growth of opportunities at the intersection of engineering, medicine, and life sciences, freshmen interested in “bioengineering” often have many questions about the differences and similarities among undergraduate programs in Courses 2, 3, 6, 7, 10, 20, and 22. This event, co-sponsored with the BEUG Student Board, was designed to help freshmen get the inside scoop about which major to choose, before the 2012 freshmen class deadline to declare a major, April 17.

“Choosing a Major” Guest Panelists:

- Course 2- Professor Peter So
Students: Shanette Go, Jeremy Franklin
- Course 3- Professor Darrell Irvine
Students: Christine Lee, Michele Lee
- Course 6- Professor Polina Golland & Professor Jay Han
Student: Ylaine Gerardin
- Course 7- Professor Graham Walker
Student: JiHye Kim
- Course 10- Professor Paula Hammond
Students: Alan Leung, Phillip Kim
- Course 20- Professor Linda Griffith
Students: Emzo de los Santos, Emilienne Repak,
Jess Ho (Course 8/20/premed)
- Course 22- Professor Jackie Yanch
Students: Dwight Chambers, Jose Pablo Perez

Goal of this Panel:

By *Professor Griffith*
FACULTY ADVISOR

Many freshmen are still not clear on how various majors mesh with their interests. Since the Course 20 major was launched 4 years ago, we have found many freshmen confuse “Biological Engineering” and “Biomedical Engi-

neering”, perhaps because MIT has an unusually well-developed landscape compared to other schools.

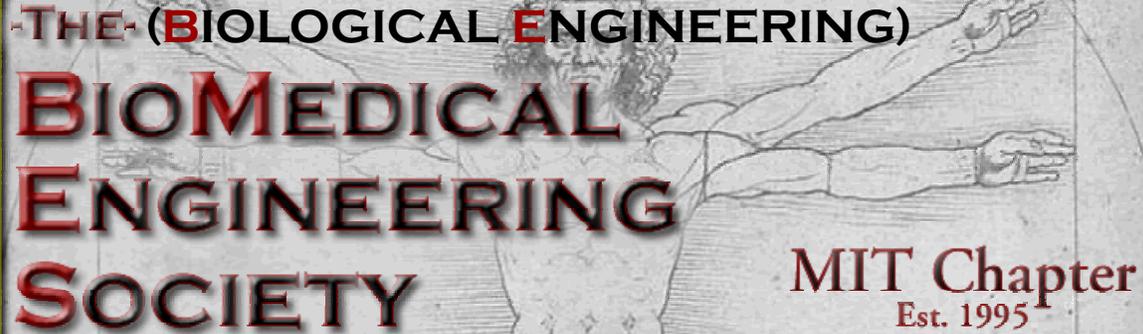
Freshmen who are mainly interested in the medicine/engineering interface for diagnostics, devices, etc, might find majors such as 2, 3, 6, or 22 (plus perhaps the BME minor) more in line with their interests, but they may not be aware of the depth of

the opportunities. Freshmen are also uncertain about the differences between engineering and science, and how a BME minor can be combined with a Course 7 major.

Hence, we hope to give students information that will help them find a resonance point with their ultimate career interests so that they choose an appropriate major this spring, or get guidance on how to focus on a couple to sample in the fall.



Professor Polina Golland describes the ways in which Course 6 can be meshed with Bio-Engineering. Freshmen from the class of 2012 listen on, at the “Choosing a Major” event in April.



**-THE- (BIOLOGICAL ENGINEERING)
BIOMEDICAL
ENGINEERING
SOCIETY**

MIT Chapter
Est. 1995

The Society is aimed at the professional development of students with an interest in BE and BME, and/or similar educational aspirations, and serves as the nexus between departments of engineering and life sciences related to BE and BME. The Society welcomes students from any major with interests at the Biology/Engineering interface.



Benefits of (BE)-BMES Membership:

- ✓ Interact with fellow students and faculty with similar aspirations
- ✓ Earn distinction for outstanding research and scholarship
- ✓ Gain exposure through distinguished lecture series, industrial site tours, and UROP & internship opportunities
- ✓ Stay informed through our members email list and the *BioTECH* publication

Visit us at <http://web.mit.edu/bmes/www/>
Email us at bmes-request@mit.edu to join



Classroom Spotlight

20.109, Fundamentals in Biological Engineering

By *Matt Luchette '11*,

FEATURES EDITOR

Whether it is the centrifuges or the students bustling around the room, the 20.109 lab seems to be whirring with activity on the last day of class. On the 3rd floor of building 56, opening onto a sunlit Stata Center, sits the lab space for the sophomore level laboratory subject 20.109, Laboratory Fundamentals in Biological Engineering. "It's the last day of classes," said the head lab instructor, Dr. Agi Stachowiak, "and students are turning in their final products." In this Cell-Biomaterial Engineering module, students finished ELIZA assays to determine if chondrocytes were growing on their modified scaffolds. Even after the class had ended, students were still hard at work, occasionally asking Dr. Stachowiak some last-minute questions. Sure, it was a sunny Friday afternoon, but who could blame them? It was easy to see what made 20.109 such a unique and exciting class to take.

It's been a long road towards making a lab class for Biological Engineering students at MIT, but today the department finally feels they have hit their stride. Since the lab class became an official course at MIT in Spring 2006, 20.109 has been cited in many scholarly publications and re-

ceived praise from institutions around the world. A fellow colleague from the Manchester Metropolitan University, United Kingdom, recently wrote Dr. Natalie Kuldell, one of the instructors: "To be honest, your courses are seen as the 'gold standard' by a lot of people outside the institution." Many of the modules have been published in lab publications, such as "The Idea of a Writing Laboratory," and "Writing and Speaking as a Scientist and Engineer: Perspectives from MIT." Since the course is also run on an open Wiki, many other lab classes worldwide can access the modules.

Before 20.109 became the 15 unit semester-long class it is today, it was run as an IAP elective in the lab of Dr. Bevin Engelward, nearly a decade ago. Enrollment was often limited, as Bio Engineering had not yet become a major at MIT. Dr. Engelward worked single-handedly to gain approval from the MIT Committee of Curricula to create the semester-long version that now satisfies the Laboratory Requirement within the General Institute Requirements (GIRs). Today, the class is run both semesters and is considered a strong alternative for 7.02, the introductory lab course for Course 7. Due to its growing popularity, enrollment is often capped around 30 students a semester. The class is unique in that its scope is far beyond what happens at the research bench; 20.109 seeks to prepare students to think about science like a researcher, as well as communicate effectively about science.

20.109 is generally split into 3 modules run throughout the term. Each module is presented by a different professor whose research is usually in the field of the project, as well an instructor

who runs the class on a day-to-day basis. This semester included an exercise in Protein Engineering with Professor Alan Jasanoff, an Expression Engineering module with Professor Leona Samson, and a project in cartilage tissue engineering called Cell-Biomaterial Engineering with Dr. Natalie Kuldell.

"The goal of the class is to gradually make the students more independent in their experiments," said Dr. Stachowiak, who has been one of the 20.109 instructors for two years. "The first module was very structured, with a clear goal in mind, and a straightforward method to get there, while the last module had many possible ways to be completed. We, the instructors, tried to make this class a mix of a traditional 'cookie-cutter' lab class and a real-life lab environment."

Dr. Agi Stachowiak further described the department's aim for the class. "Apart from exposing students to basic lab investigation techniques, the overarching theme of the class is authentic investigation. As a Communication Intensive (CI) course, the class teaches students how to initiate a research project through investigating primary literature, and then takes the students through the entire research process; after performing their experiments, students must analyze their results, draw conclusions, and present their findings to the class. The course has a writing instructor, who helps students prepare professional presentations for the class. Funding for many of the expensive, cutting-edge experiments has been both extensive and well supported by the BE department. The department realizes how important 20.109 is for the future of Course 20," remarked Dr. Stachowiak. "The class is here to stay."



Students fabricated electrochromic devices out of M13 phage in the third module of 20.109, Fall 2007.